Journal of the Royal Society of Arts

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THE SOCIETY'S CHRISTMAS CARD

An illustrated order form for the Society's Christmas card, including details of prices, is included at the back of this *Journal*. It is regretted that, as a result of the recently negotiated rise in wages in the printing industry, it has proved necessary to increase the cost of this year's card to Fellows.

THE LIBRARY

The redecoration of the Library is now completed, and Fellows may resume use of the room and the borrowing of books from the Society's collection.

Fellows are reminded that in addition to the Library, the accommodation at their disposal in the Society's house includes the ground-floor Parlour, where light refreshments (such as morning coffee, sandwiches and afternoon tea) can be ordered between 10 a.m. and 5.30 p.m. on weekdays, and until 12 noon on Saturdays.

INDUSTRIAL ART BURSARIES EXHIBITION

As announced in the last issue of the *Journal*, the exhibition of designs submitted in the 1958 Industrial Art Bursaries Competition will be on view at the Belfast College of Art from 7th to 21st September.

THE WORK OF THE HISTORIC CHURCHES PRESERVATION TRUST

A paper by

THE EARL OF EUSTON,

Deputy Chairman, Society for the Protection of Ancient Buildings, read to the Society on Wednesday, 20th May, 1959, with the Rt. Honble. Viscount Crookshank, P.C., C.H., Chairman, Executive Committee, Historic Churches Preservation Trust, in the Chair

THE CHAIRMAN: I should perhaps explain that the reason why I am here this afternoon is that since this lecture is devoted to the work of the Historic Churches Preservation Trust it was thought a good idea that, as I am the Chairman of its Executive Committee, I should preside. I know that you will be interested in what Lord Euston will say and what he will show us, because he has naturally a most interesting topic to display before you. He is one of the Trustees of the Trust and he is also the Deputy Chairman of the Society for the Protection of Ancient Buildings, so you can imagine that the combination of those two functions gives him a wealth of knowledge.

The following paper was then read.

THE PAPER

I have been asked to speak to you this afternoon about the Historic Churches Preservation Trust. I think that before I enlarge on the present position I must give you briefly the history of the Society for the Protection of Ancient Buildings, of which I am the Deputy Chairman, and which was the pioneer in this whole field of Church Preservation.

Up till 1877, the only body helping the fabric of the churches was the Incorporated Church Building Society, which was not a preservation body, but was formed in 1818, mainly to assist in providing additional church accommodation. The repeal of the Church Rates Act in 1868 had removed the obligation on the part of all living in a parish to contribute to the maintenance of the parish church. After that date the church had to rely on its congregation to provide the necessary funds. From then until 1877, nothing was officially done to help the churches, but on 10th March of that year there appeared in what was then a leading periodical, *The Athenaeum*, a violent letter protesting against the threatened scraping and scouring of Tewkesbury Abbey. It was written by William Morris, who was the first person to realize that little good could come of individual opposition to specific cases of vandalism, and saw that a general offensive would have to be taken against the Philistines, and he concluded his letter with the words: 'What I wish for, therefore, is that an association should be set on foot to keep watch on old monuments, to protest against all restoration that means more than keeping out wind and weather, and by all means, literary and other, to awaken a feeling that our ancient buildings are not mere ecclesiastical

toys, but sacred monuments of the nation's growth and hope'.

As a consequence of the publication of this letter a meeting of all those interested in the subject was proposed, and by invitation of Morris, they met at the showroom of his famous art and craft firm of Morris & Co., in Queen Square, Bloomsbury.

When telling you the history of the Society, I think it worth giving you a very brief history of William Morris, its founder, who must surely have been one of the most remarkable figures ever produced by this country. He was born in 1834 and died in 1846, and during those 63 years he was a painter, designer of furniture, textiles and stained glass, a printer who founded the Kelmscott Press, a very good poet and writer of prose, and as well as this found time for politics and was one of the founders of the Socialist Party. His character was so many-sided that it perhaps prevented him from ever reaching the summit in any one field but he and his associates—John Ruskin, Philip Webb, Burne Jones and Rossetti among them—did succeed in really altering taste in the last century and, although they made many mistakes, played the largest part in raising taste from the deplorable level of the mid-Victorian era.

I do not know if any of you have heard of the Red House at Bexley, which Morris and Philip Webb built together in 1859, and which, if one sees it now, does not appear to be in any way remarkable. When it was built it represented something entirely new, and was the beginning of a complete change in design.

To revert to the beginnings of my Society, at the first Committee Meeting its title was decided and, owing to the Tewkesbury Abbey controversy, the Society was known for many years as 'Anti-Scrape'. The Society used to meet every Thursday afternoon in the showrooms of Morris & Company, and its first committee was a constellation of famous names: John Ruskin, Holman Hunt, Burne Jones, Thomas Carlyle, and in addition, Philip Webb, Charles Keene, Richard Doyle, Sir John Lubbock. It would be difficult to find in any age a body of men, brought together with a common end and aim, containing a higher degree of intellectual ability. Our present Chairman, Lord Esher, recalls meetings in his early days on the committee as being held in 'an uproar of obscure enthusiasm'.

From this aggressive beginning the Society has travelled far. It was actually founded to prevent the Victorian restoration and subsequent ruination of churches, too many of which had already been destroyed before 1877. From that beginning, it developed into a technical and advisory body, willing and—by reason of the constitution of its committee—competent to give proper advice upon the methods to employ; to quote the original manifesto: 'how best to protect buildings', 'to stave off decay by daily care', 'to prop a perilous wall, or mend a leaky roof, and show no pretence of other art, and otherwise to resist all tampering with either the fabric or the ornament of the building as it stands'.

These were the fundamentals of the manifesto compiled by the founders, and in spite of the additional knowledge which the experience of over eighty years has gained for us, this manifesto still holds its place and still governs in principle the action of the Committee to-day.

The next step in the consideration of the care for the fabric of the churches was in 1912, when a Select Committee of both Houses of Parliament proposed that parish churches and cathedrals should be included among the ancient buildings which the then Office of Works were proposing to protect from destruction or disfigurement by new and extensive powers. There was a strong feeling, however, that the churches could and should be supported by their own congregations, and Archbishop Davidson confirmed the exclusion of ecclesiastical buildings in use from the Ancient Monuments Act of 1913 by an undertaking, frequently referred to as the Archbishop's pledge, in which he said: 'The Archbishop of York and I have been considering carefully whether we could profitably take any step which would be likely to be advantageous, so that they may not be made rashly and harm may not inadvertently be done'. The outcome of the considerations the Archbishop refers to was the setting up, under the chairmanship of Sir Lewis Dibdin, of the Ancient Monuments (Churches) Committee, whose report was published in 1914.

In that year the Archbishop, in fulfilment of this pledge in the House of Lords, appointed a Commission which reported and recommended that an Advisory Committee should be set up in each diocese to help the clergy, and to guide the chancellor of the diocese in granting faculties. Then war broke out, and it was not until 1916 that such great figures as Bishop Gore, Dr. Eeles and other members of the Victoria and Albert Museum staff formed a Diocesan Advisory Committee in Oxford, principally to safeguard the standard of war memorials, and this lead to advising on the preservation of the fabric of churches. These local advisory committees increased, and a Central Meeting was held in the Jerusalem Chamber at Westminster in 1921. Two years later, on 23rd March, 1923, the first Constitution of the Central Council for the Care of Churches was ratified.

Dr. Eeles, who had been the leading spirit in its formation, became its first Secretary, and devoted his entire life to work for this cause. It was not until 1938 that the existence of the Diocesan Advisory Committee was recognized by the Church Assembly, and there is now one in every diocese in England, with the exception of Sodor and Man. The Church in Wales also has Diocesan Advisory Committees in every diocese.

Between 1923 and 1939—a period which showed a marked decrease in church-going—the situation became worse, and by 1939 the problem was already acute. Then came the Second World War, which meant that for ten years no repairs were carried out.

Various bodies sprang up after the war, such as the Friends of Ancient English Churches, but they could do little but draw the attention of the authorities to the gravity of the situation, which was obviously beyond the scope of voluntary societies, and had become a national problem. The Archbishop of Canterbury was prevailed upon by the Pilgrim Trust and the Society of Antiquaries, and urged by the S.P.A.B. and kindred bodies, to call a meeting and to appoint a Commission to report on the situation. A Report was published in 1951 advising, among other recommendations, the creation of the Historic Churches

Preservation Trust, whose function would be the launching of a public appeal. The Trust was immediately recognized, and it received the support of leaders in all branches of the national life, one of the Trustees being the Prime Minister.

The target for the public appeal is £4,000,000, of which £2,000,000 is to come from the Parent Trust in London. In theory, there were to have been 40 County Trusts, each with a target of £50,000, but unfortunately it has not been possible to carry out this distribution fully, owing in some cases to corresponding local appeals, to which county authorities were already committed. In fact, only 14 of the County Trusts have been set up. The Parent Trust in London has so far raised £553,000 in cash and promises, and the affiliated County Trusts £206,000; making a grand total of £759,000. Since its inception, grants totalling £376,574 have been voted to churches and chapels in every part of the country. In addition, a substantial number of interest-free loans have also been made available, usually to allow of the uninterrupted continuity of repairs which had already begun.

It must be stressed that the Trust is independent, and bodies from any denomination are free to apply for assistance. Inevitably, the largest proportion of grants has so far gone to Church of England properties. It is perhaps not realized that the Church of England is responsible for 16,000 parish churches, as well as vicarages, schools and halls. In addition to these buildings, most of the medieval sculpture in wood and stone, and wall paintings, and the greater part of medieval church and cathedral plate and textiles, are maintained in Anglican places of worship. The very small amount of Renaissance glass in this country is almost entirely found in the churches, as well as a very large proportion of Renaissance church plate and textiles. For the upkeep of these priceless treasures, no contribution—either direct or indirect—is received from the State.

Since the inception of the Historic Churches Preservation Trust, enormously varied efforts to raise money have been tried.

The main drive has, of course, been in postal appeals and advertising. Thousands of appeal letters go out yearly, but in spite of different attempts to arouse interest—such as the 'Silver Steps' at St. Martin-in-the-Fields, exhibitions, musical recitals, etc.—evoking the response has on the whole been an uphill struggle. An event which is causing a great deal of interest is the auction sale of objects of art which is to be held next July at Christie's.

I do not want to seem to be only complaining, and must add at this point that the individual church appeals throughout the country have for many years been supported with unbelievable generosity. Contributions for the Appeal have come from all sorts and kinds of people: moneys ranging from the sixpences of schoolchildren to the grant from the Pilgrim Trust, who are giving £100,000 over a period of ten years. At the time of the grant, this was the largest single gift ever made by the Trust.

I have already referred to the Archbishop's Special Commission of 1951, which led to the foundation of the Trust. The whole subject was exhaustively examined, and the Commission produced another valuable recommendation which resulted in the passing in 1955 of the Inspection of Churches Measure,

which ensures that every church shall be examined by a qualified architect at least once in every five years. This measure has revealed the damage done in the past by lack of professional advice, and inspection has in many cases recorded the plight of a remote village, where perhaps 90 people have to care for a large and valuable church. Incidentally, these inspections have revealed an even more serious state of affairs.

When the problem of the historic country houses was being tackled by the Gowers Commission, it was said that the country was facing, in the decay of the country houses, an architectural disaster only comparable with that which resulted from the dissolution of the monasteries in the sixteenth century. Similarly, after the war the country was faced with the prospective loss of more valuable old churches than at any time since the close of the Middle Ages.

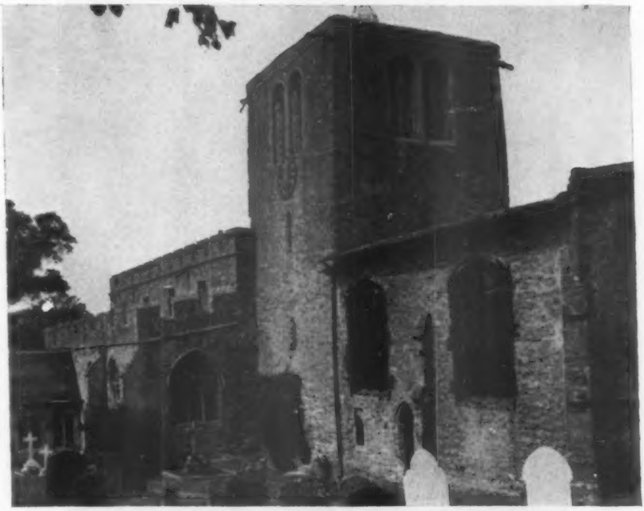
I believe that the formation of the Historic Churches Preservation Trust has done more to avert this danger than any other action, and has set in motion a spate of repairs to these historic buildings such as has not been seen for a hundred years.

The Lecturer then showed a number of lantern slides of churches to which the Trust has made grants in recent years; a selection of these appears in the following pages.

[Photograph by A. R. B. Wylam

ST. MARGARET'S, MORTON-ON-THE-HILL, NORFOLK

This church, of Saxon origin, possessed one of the forty round towers in the country, the upper part of which collapsed in April, 1959. A grant is under consideration.



[National Buildings Record

ST. PETER'S, THURLEIGH, BEDS.

This church stands on the site of an old Roman fort and was built originally in early Norman times, the central tower being the only surviving part of this structure. Parts of the Norman walls are incorporated in the early English chancel; the nave was largely reconstructed in 1882, when extensive repairs were carried out to all parts of the fabric. Since then the church had been left uncared for until about 1954. Plans for the demolition of the nave and aisle had been prepared when the Trust intervened with grants totalling £2,000 and a substantial interest-free loan, which enabled the necessary restoration to be begun.

[*National Buildings Record*

ST. ANDREW'S, SOUTH LOPHAM, NORFOLK

The chief feature of this church is its central Norman tower with arcading in successive stages. This is unique in South Norfolk. The building is partly Saxon in origin but now appears to be mainly Norman, with a doorway, window and parapet of the thirteenth, fourteenth and fifteenth centuries. Other features of interest include a small circular Saxon window with a series of holes in its lower edge and below, and a Norman doorway which has been blocked up. Internally the nave has a plain hammer-beam arch-braced and -collared roof with hung post. The columns of the fourteenth century arcade between the nave and south aisle are of unusual clustered design. The whole building is in dire need of restoration, and repairs estimated to cost £12,000 have begun with two grants from the Trust totalling £1,500.

[*National Buildings Record*

ALL SAINTS', EARL'S BARTON, NORTHANTS

Of the original Saxon church on this site, the tower is the most impressive remaining evidence. It is believed to have been built about 970, in replacement of a wooden tower which dated from the seventh century. It is composed of four stages, and on the exterior of each face there are decorations consisting of flat vertical strips and projecting stone. There are still traces of a moat which surrounded this tower. Much of the church was rebuilt in the fourteenth and fifteenth centuries, though traces of Norman, as well as of Saxon, work may still be seen.

The Trust has made two grants, totalling £786.

[*National Buildings Record*

ST. MARGARET'S, KING'S LYNN, NORFOLK

The first church on this site, completed by 1101, was pulled down, and a new one built, in the thirteenth century. A lantern tower over the transept crossing was added in about 1330. The west window (shown here) was built in about 1453, which is also the date of the north-west tower. In 1741 the spire on the south-west tower fell in a great gale, crushing the nave roof and damaging the arcade. The nave and its aisles were subsequently rebuilt, and the lantern removed. The fine stalls and parclose screens in the choir are of the fourteenth century.

A grant of £2,000 has been made by the Trust.

[*By permission of the Controller, H.M.S.O.*

ST. MARY'S, ABBEY DORE, HEREFORDSHIRE

The church is notable not only as the remains of a magnificent Cistercian abbey founded in the twelfth century, but also for the details of work of this and subsequent periods which it contains, including the Jacobean screen shown in this photograph and, more especially, a considerable amount of wall painting. There may be seen evidence of an elaborate scheme of decorations painted in 1630–40, and an extensive series of texts, Royal arms and figure subjects of 1701.

The east wall of the Presbytery, with its three graduated lancet windows borne on an arcade of three bays, is an exceptionally fine example of early thirteenth-century architecture.

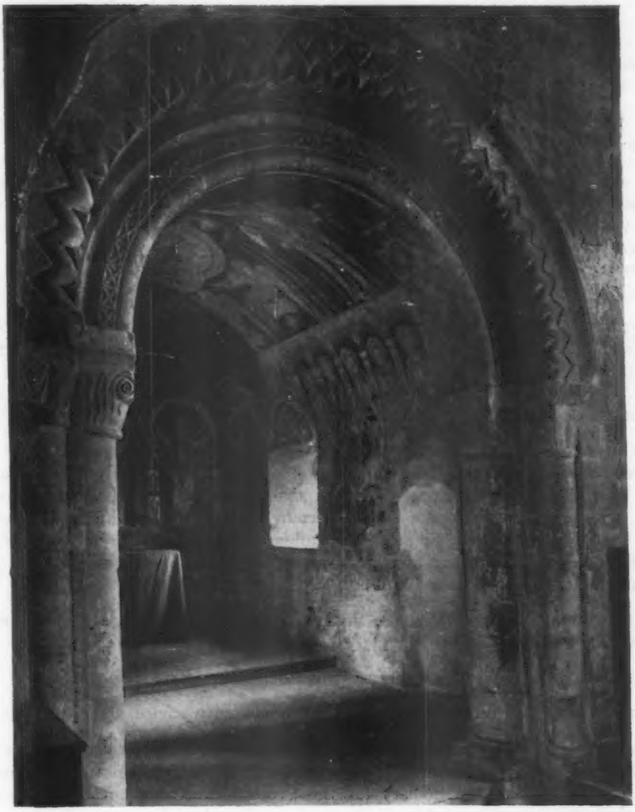
The Trust has made a grant of £2,000.

[*The photograph is reproduced from Volume I of* An Inventory of the Historical Monuments in Herefordshire (*Historical Monuments Commission, 1931*)]

HOLY TRINITY, BLYTHBURGH, SUFFOLK

The present church was built in the fifteenth century (though there was an earlier church on the same site) and consists of nave and chancel, both with side aisles, a sanctuary, west tower and south porch. It has a lofty arcade surmounted by a clerestory and covered with an arch-braced cambered tie-beam roof (shown here) still retaining much of its original painted decoration. Also inside the church are a fine lectern and Jacobean pulpit, and a series of bench ends with figures depicting the seven deadly sins.

The Trust has so far made a grant of £350.



[By permission of J. R. H. Weaver

ST. MARY'S, KEMPLEY, GLOS.

Mainly of Norman origin, the church consists of a nave and chancel, central tower and south porch. The chief interest of the interior is found in the wall paintings, which date from the early twelfth century and were discovered under limewash in about 1860. At the time of their execution, these paintings had been coated with a shellac varnish to preserve them, but this coat had gradually darkened to black and all trace of the paintings had disappeared. It was thought that they had faded beyond recall, but recently it was discovered that any solvent will remove the varnish, and under this was found a complete decorative scheme. The photograph is of a view through the chancel arch, showing paintings on the south wall, vault and east wall of the chancel.

Two grants totalling £850 have been given by the Trust to assist this work of restoring the paintings.

DISCUSSION

A MEMBER OF THE AUDIENCE: I should like to ask if the broadcast appeals have very encouraging results?

THE LECTURER: Not very encouraging. They bring in only about £300 on the average.

MR. P. I. ADDISON: In some quarters it is suggested that preservation councils tend to value something as beautiful merely because it is old; there is also a criticism made, particularly in the light of the liturgical movement of to-day, that preservation bodies wish to keep a church as it has been, and do not allow for the needs of the community and the liturgical movement of to-day.

THE LECTURER: I can only say that we are guided by the amount of money we have to distribute. There is a grants committee on which many people with differing views and differing Churchmanship sit, and we really have to deal with each case on its merits. The main factor is, of course, that there is far too little money to go round. At every meeting of the grants committee—Lord Esher will bear me out in this—one is deluged with applications. One has to select the best.

MISS ROSAMUND BORRADAILE (of the Society of Painters in Tempera): May I put in a plea for the mending of the old monuments before they are painted? So often artists have difficulty in getting the right material, such as alabaster or stone or marble, before the monuments are in certain cases to be regilded or repainted. I have been offered cement. So often the builders that are called in by the architects say, 'Oh, no, you cannot get that stone-moulding done nowadays, you had better use cement'. It is impossible to paint and gild on such a surface.

THE LECTURER: I do not think the Society would ever approve of cement instead of the original material.

MISS BORRADAILE: May one apply to your Society in a case like that?

THE LECTURER: Yes, our Society is always ready to give advice.

BRIGADIER J. L. P. MACNAIR: I should like to ask if Lord Euston could tell us a bit more about what co-ordination there is. I am a member of the Ancient Monuments Society; here we have the Society for the Protection of Ancient Buildings; and I think there are one or two other similar societies like that. I suppose there must be a link between the Society for the Protection of Ancient Buildings and the Ancient Monuments Society, but I should appreciate it if you could just tell us what happens when an application goes to one which perhaps should be dealt with by another, or in matters of that sort. I remember bringing to the notice of the Ancient Monuments Society the case of a very notable house in Wales that some contractor was proposing, in a light-hearted way, to pull down. The Ancient Monuments Society referred the thing to somebody else, but in the end we were too late, and the house was pulled down!

THE LECTURER: I feel strongly that it is a great mistake to have too many societies all doing the same thing, but the Ancient Monuments Society has, I believe, so far really only functioned in the north of England, and so our two fields have not obviously conflicted. They have now, however, moved to London, and I foresee difficulties with two societies with almost the same name doing the same thing.

MR. A. POWIS BALE: I rather hoped that Lord Euston might have mentioned the

very interesting type of church which has a separate bell tower. I wonder whether such bell towers come within the scope of the Trust's activity?

THE LECTURER: I am sure they do. West Walton church, for example, has already received a grant.

THE CHAIRMAN: Lord Euston has brought home some of the problems with which the Historic Churches Preservation Trust has to deal. In our leaflets and lectures we often speak about the great national heritage that the ancient churches are. That may seem a cliché until you have seen some of these beautiful photographs. Then you begin to appreciate what is meant. Lord Euston showed us thirty or forty churches at the most, and that figure can be multiplied and remultiplied. The need is very great. I ask you to remember that the work of the Trust if far from finished. Any help that you can either give yourselves or influence others to give—to either the County Trusts, which do the same work, or to ourselves, the parent body in London—will be most thankfully received and most faithfully applied.

I ask you now to show your appreciation of Lord Euston's interesting lecture.

The vote of thanks to the Lecturer was carried with acclamation and, another having been accorded to the Chairman upon the proposal of Sir Alfred Bossom, the meeting then ended.

THE COMMONWEALTH TRANSANTARCTIC EXPEDITION

The Thomas Holland Memorial Lecture by

SIR VIVIAN FUCHS, M.A., Ph.D.,

delivered to the Commonwealth Section of the Society on Tuesday, 27th January, 1959, with the Rt. Honble. Lord Cohen of Birkenhead, M.D., F.R.C.P., in the Chair

THE CHAIRMAN: Sir Thomas Holland was a former Chairman of the Council of this Society, a Vice-President, and an Albert Medallist. He was distinguished in two main fields, those of geology and of administration. For many years Director of the Geological Survey of India, he was later Rector of the Imperial College of Science, and I think for about fifteen years he was Vice-Chancellor of the University of Edinburgh. Sir Thomas was a man of tremendous friendly charm whom I had the privilege of knowing, and there is no one who can do greater justice to his memory than Sir Vivian Fuchs, who has served almost in the same fields of geology and exploration.

Now Sir Vivian is a figure of world stature, but we Britishers regard him with a special pride and affection as one of ourselves. He had served a long apprenticeship as a geologist and an explorer in many parts of the world before he was seconded from his post as Director of the Falkland Islands Dependencies Scientific Bureau to lead the Commonwealth Transantarctic Expedition in 1955. In this adventure he and his party showed intrepid courage and consummate skill, surmounting what to many would be insuperable obstacles. Sir Vivian's leadership of this expedition was inspired. The saga of the expedition which is recorded in his book with an enviable modesty—not always a feature of modern autobiographies—will forever be inscribed in our nation's story. It compels admiration as a superb example of that adventurous and daring spirit which through the centuries has inspired the people of this island. No one doubts that Sir Vivian's achievement will take its place alongside those of Drake, of Cook, of Scott, and Shackleton.

The following lecture, which was illustrated with lantern slides, was then delivered.*

THE LECTURE

The British Commonwealth Trans-Antarctic Expedition was supported by the Governments of the United Kingdom, New Zealand, Australia and South Africa. Being a privately organized venture it also drew financial and other support from the public and industry in the United Kingdom and in New Zealand, for these were the prime movers in the expedition.

The object was not merely to cross the Antarctic Continent, but to make exploratory and scientific studies throughout the two years that were spent in the field. The work included topographical mapping, geological survey,

*The lecture delivered to the Society was *ex tempore* and based on a large number of lantern slides, and was thus unsuitable for publication in its original form. The version which appears here is substantially the same as that first published by the Royal Geographical Society, whose permission to reprint is gratefully acknowledged.

glaciology and meteorology, seismic sounding of the ice depth across the continent, a gravity traverse and physiological studies of man's acclimatization during a prolonged period of extreme cold.

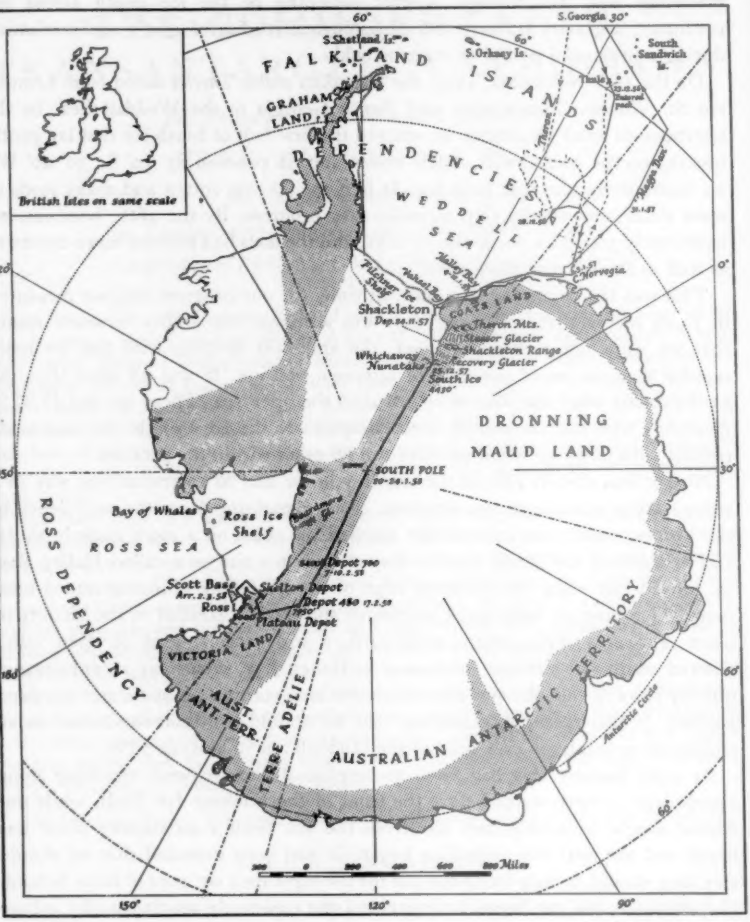
On the 14th November, 1955, the Canadian sealer *Theron* sailed from London *via* St. Vincent, Montevideo and South Georgia to the Weddell Sea. In the afternoon of 22nd December we entered the first belt of brash ice that lay gently heaving on the ocean swell. A few hours later, in position 63° 50′ S., 30° 20′ W., we encountered the true pack ice. At first the ice was rotten and many leads of open water allowed the ship to make easy progress. By the 26th, however, we were nearly 300 miles inside the ice edge, and the floes had become more extensive as well as thicker and more solid.

This was the beginning of a difficult time, for our progress became measured in yards rather than miles per day, and although our ability to move meant that we were not technically beset, the ship was drifting with the ice more rapidly than we could progress of our own volition. It was 28 days later, on 23rd January, that the *Theron* returned to the open sea. There we met H.M.S. *Protector*, who had come with her helicopters to the edge of the ice and made contact with us by air when we were still 60 miles within the pack ice.

Now it was already late in the season and we had to hasten on our way in a second attempt to reach the antarctic coast. Benefiting from the experience of the *Tottan*, which had successfully reached the coast on a more easterly route, and established the Royal Society Expedition at a site now called Halley Bay, we moved east along the northern edge of the ice before plunging into it once more. This time we were more successful and made a landfall in the vicinity of Cape Norwegia. From there southward, a wide coastal lead of open water allowed us to sail without hindrance to Halley Bay, where air reconnaissance quickly showed that the site was unsuitable as a starting point for our overland journey. It was essential, therefore, that we should continue southward in an endeavour to reach the very head of the Weddell Sea in latitude 78°S.

By 29th January this had been accomplished and we were steaming along a wide lead of open water before the front of the Filchner Ice Shelf, while our Auster sought a suitable base site from the air. Soon a satisfactory place was found and the next day unloading began. It had been intended that we should stay long enough to help build the hut for the eight men we were to leave behind. Unfortunately the sea began to freeze and the constantly moving pack ice bore down on the *Theron* where she lay at the ice edge and we were forced to hurry our departure. But before the ship left on 7th February a local reconnaissance flight around Vahsel Bay had reached a range of mountains far to the south. On the day of our departure a flight was made to this range, which we named, the Theron Mountains.

As soon as the eight men we had left behind under the command of Kenneth Blaiklock had waved goodbye to the ship they set about the preparation of temporary quarters in a huge crate which had contained a Sno-Cat. Then they began carrying up to the base site the safety requirements of food and fuel, besides the components of the main hut which they hoped to construct before



[Royal Geographical Society

Antarctica. (The limits of known land are shaded)

the onset of winter. Because the ship party had been unable to begin this work there proved to be far more to do than could be accomplished by so few men in the time available. The weather too was against them.

Six weeks after the ship left, a storm broke up the sea ice on which many of the stores still lay, and nearly everything that had not been carried up to the base site was lost. Fortunately, the party had sufficient fuel and food, and all the components of the main hut. But this loss committed them to an anxious

and uncomfortable winter during which they lived in the converted Sno-Cat crate and slept outside in two-man tents, even when the temperature dropped well below –60° F.

We who had returned to London began a second period of intensive preparation; this time for our final departure with more men, vehicles, aircraft and stores, to build up the necessary potential at Shackleton before we could set off on the continental crossing. On 13th November, 1956, Her Majesty the Queen, Patron of the Expedition, inspected the ship. Two days later, we once again sailed from the Port of London; this time in the newly built *Magga Dan*, a Danish vessel specially built to operate in ice. Besides our own party and stores we carried the relieving personnel and more equipment for the Royal Society's Expedition at Halley Bay.

After calling once more at South Georgia to bunker the ship we sailed south on the last leg of our return voyage to Shackleton. This time the ice was first encountered in position 58° 38′ S., 30° 00 W., during the evening of 22nd December. Six days later, in latitude 68° 22′ S., 16° 44′ W., we entered a huge area of open water that extended for 100 miles to the south. This enabled Captain Petersen to set the automatic pilot, and for a few hours we thought that perhaps we were to sail an uninterrupted course to our destination at 78° S. These hopes faded when we again entered very close pack ice in latitude 69° 43′ S., and were compelled to turn back and work the ship for several days towards the east. After many vicissitudes, the *Magga Dan* reached the open water of the coastal lead on 4th January, 1957. That evening we arrived at Halley Bay and began unloading the stores for the Royal Society Base. Our de Havilland Otter was also off-loaded and the wings fitted, so that the plane could fly south to Shackleton in advance of the ship. But before doing this we flew eastward to investigate the possible existence of mountains, for Surgeon Lieutenant-Commander David Dalgliesh had reported seeing a dark speck above the horizon. After flying 230 miles inland, which brought us over Norwegian territory, two fine ranges of mountains were seen. Flying around the peaks of the most easterly of these, we estimated the greatest height to be over 9,000 ft. Even so, for Dalgliesh to have seen them meant that they must have been greatly refracted by air of different temperature in the lower layers.

Next day, 12th January, we flew south to Shackleton, observing on the way the ice conditions and reporting them by radio to the ship which was to follow us the same day. After two and a half hours in the air we landed at Shackleton to be greeted by the wintering party, and to hand over their mail and the various delicacies we had brought for them. The following afternoon the *Magga Dan* arrived after an unexpectedly easy passage from Halley Bay. During the next sixteen days the activity at Shackleton was fast and furious; hundreds of tons of stores were moved up to the base, new buildings were erected and the ship took sealing parties along the ice edge to complete the stock of dog food for the winter.

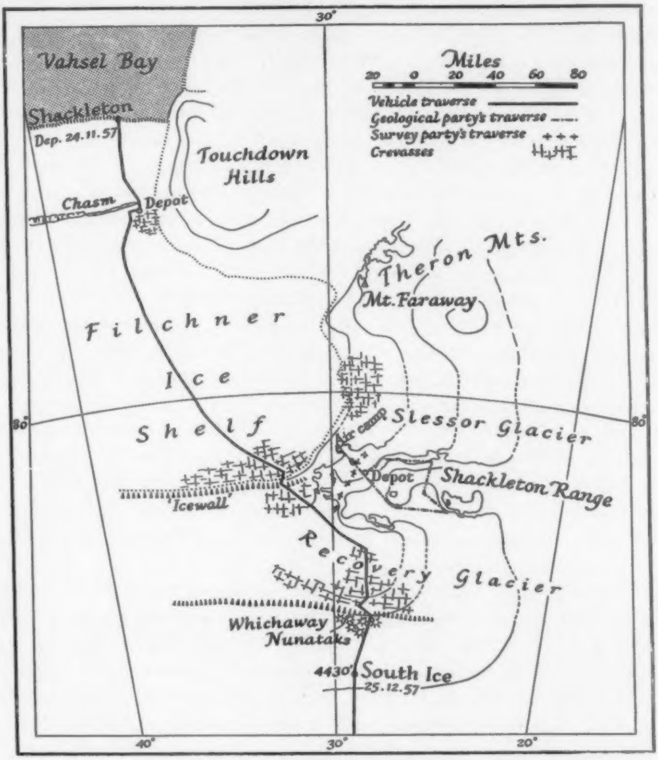
On 29th January the ship left, and as we watched her go we knew that no other ship could come to fetch us—our way out lay 2,000 miles across the

continent. Soon we found that our greatest problem would be manpower, for there were so many things to do and somehow it seemed necessary to do everything at once. The most important and urgent task was to continue the aerial reconnaissance for the site of the inland station which was to be set up about 300 miles to the south. This we intended to be for meteorological and glaciological purposes during the winter, and later to serve as the main depot for supplying the trans-continental party. It was therefore of prime importance that the site selected should be accessible on the ground and not only by air. The southern dog journey made by Blaiklock and Goldsmith of the Advance Party, and our subsequent flight, showed that the major problem would be to get our vehicles over the crevassed areas that marked the junction of the floating ice shelf with the ice resting on solid rock.

South of the base we found that there were two ranges of mountains and one group of nunataks, all extending in a general east-west direction. Between them two major glaciers flowed from the east into the Filchner Ice Shelf. The northern mountain range we had already named the Theron Mountains; the southern was now christened the Shackleton Range. Between them flowed the Slessor Glacier, 20 to 30 miles wide and some 90 miles long. South of the Shackleton Range lay the Recovery Glacier, 40 miles wide and at least as long as the Slessor, although we never did see its eastern beginning. On the southern side of the Recovery Glacier lay the Whichaway Nunataks, a small group of rocky hills, which later proved to be the last rocks we were to see until approaching the edge of the continent 1,500 miles away.

The site finally selected for the inland station, to be called South Ice, was about 30 miles south of the largest of these nunataks. Later the position was determined as 81° 47′ S., 28° 48′ W., and the altitude 4,430 ft. We had always planned to establish South Ice with both ground and air transport, but it soon became clear that there would be no time to force a ground route so far south before the winter of 1957. It was therefore decided to fly the entire station and stores in with the Otter. On 4th February John Lewis flew Lister, Blaiklock, Stephenson and Lowe to the site, together with supplies for 30 days. While they were building the small prefabricated hut, flights were made to South Ice whenever the weather was suitable. On the 25th March the last of twenty flights had been completed and Lister, Blaiklock and Stephenson were left to settle down for the winter and to carry out the meteorological and glaciological programme.

While South Ice was being built, Stephenson and Blaiklock had been transported by air to the Whichaway Nunataks, where they were left with supplies for 10 days, to survey and study the geology of the group. Unfortunately a period of bad weather then prevented the plane from picking them up. As the days passed, we became more and more anxious for we knew that when they had only a few days food left they would have been compelled to start manhauling back to South Ice. After an abortive flight on 11th March, when heavy drift made it impossible to find the party, we succeeded in picking them up on the 15th. By this time they had reached a point about 12 miles from South Ace, but had



[*Royal Geographical Society*

Route from Shackleton to South Ice

only one day's rations and half a fill for the Primus left. As they struggled over the hill and dale surface the weather had been appalling, with winds of from 20 to 35 knots and temperatures ranging between −25° F. and −47° F. As a result of their experience they were somewhat frostbitten, but not seriously so.

At Shackleton we now settled down for the winter. The aircraft were 'put to bed' in the snow and tunnels were dug to protect the dogs from the increasing cold and the winter winds. At the same time we completed the engineering workshop, which had long been delayed, and prepared to tackle the innumerable tasks which would have to be accomplished before the beginning of the spring journeys which we planned to make before setting out on the crossing of the continent.

While all these events had been taking place at Shackleton, Sir Edmund Hillary and his party from New Zealand, including Dr. Marsh and Lieutenant

Brooke from Great Britain, had reached McMurdo Sound on board H.M.N.Z.S. *Endeavour*. Unfortunately, many miles of unbroken sea ice separated the ship from the chosen base site at Butter Point. They therefore sought and found another position at Pram Point on Ross Island, some miles across the Sound. Together with expedition members, a construction unit brought from New Zealand set about the building of the base. At the same time reconnaissance flights were made to find a route up the Skelton Glacier, for the original idea of ascending the Ferrar Glacier had been shown to be impossible.

By 27th January two dog teams, four men and the necessary supplies had been flown to the foot of the Skelton and the party began to work its way up to the high plateau at 8,000ft., where they arrived on 8th February. On the same day the Beaver completed the stocking of a depot at the foot of the Skelton and soon began flying stores up to the plateau, where a second depot was quickly established. On 22nd February the *Endeavour* sailed for New Zealand and the base party settled down to winter tasks, just as we had done at Shackleton.

Before the sun finally disappeared Hillary led a tractor party to Cape Crozier over the route followed by Wilson, Bowers and Cherry-Garrard on their *Worst Journey in the World*. During this trip the temperature dropped as low as −46° F., and they experienced their first difficulties of cold temperature vehicle maintenance. Throughout the winter the dog teams were given runs to keep them fit, and from time to time when the weather was good the Auster flew out over the surrounding country.

At Shackleton we had planned to begin our spring journeys on 1st September and to carry out the relief of South Ice shortly afterwards. As it turned out, the temperature on that day was −60° F.—scarcely suitable for the start of a journey. Later the temperature rose to as much as −40° F., but strong winds brought high drift and no visibility, so that our ambition to make an early start in the year was still frustrated. Soon it became apparent that South Ice would not be relieved until October, but in the meantime there came bad news. Robin Smart, leader and doctor at Halley Bay, had received internal injuries from a fall and needed medical assistance. Fortunately the Auster was almost ready to fly after its long incarceration in the snow and Gordon Haslop took off with Dr. Rogers, expecting to arrive at the Royal Society Base less than three hours later. Unhappily the shifting snows of winter had changed the scene and they missed the base. Then darkness forced them down on the ice shelf where they lived in a snow pit for ten days before the weather allowed the Otter, which we had hastily prepared, to fly to their relief.

On 8th October, three days after the Auster Party had been picked up, a vehicle group consisting of David Pratt, Geoffrey Pratt, Roy Homard and myself set out on the first surface reconnaissance journey to South Ice. Three days later two dog teams together with David Stratton, Ken Blaiklock, Jon Stephenson and George Lowe were flown to the Shackleton Range to begin survey and geological work. By flying the men and dog teams to the site of their work much time and effort was saved, and a survey of the Shackleton Range was made which would otherwise have had to be abandoned.

The South Ice reconnaissance party soon encountered trouble with the wide areas of crevasses occurring in the Filchner Ice Shelf but, with the assistance of air observation, overcame these obstacles both on the Ice Shelf and on the Recovery Glacier beyond the Shackletons. In spite of this air assistance and the discovery by the dog teams of a reasonable route up the steep ice wall which marked the southern boundary of the ice shelf, it was thirty-seven days before we had forced our way through to South Ice. Then on the thirty-ninth day we flew back to Shackleton in two and a half hours.

Ten days later, on 24th November, the main journey across the continent began, but this was two days later than we had planned. By this time the survey and geological parties had been withdrawn by air from the Shackletons and everyone had been busily preparing for the main journey. On the reconnaissance to South Ice there had been nine major recoveries of weasels sunk deep in crevasses; one weasel had to return to base after a few miles and a second had been abandoned after 200 miles, leaving only one weasel and a Sno-Cat to arrive at South Ice. This was a warning that we must carefully preserve every remaining vehicle if we were satisfactorily to complete the crossing of the continent.

During the reconnaissance the temperatures had been generally between −25° F. and −45° F.: now, six weeks later, the temperatures at sea level were uncomfortably high at +10° F. to +20° F. The advancing season had also made the crevasse bridges weaker and we were soon in trouble recovering one Sno-Cat or Weasel after another from the most unpleasant holes into which they fell. Even so, the probing technique which we had devised to find a route through the crevasse belts saved us from losing any of the vehicles or sledges.

By 22nd December we had again reached South Ice, where we joined Geoffrey Pratt and Hannes La Grange, who had been doing seismic and meteorological work at the station. Next day Blaiklock and Stephenson set off south with two dog teams. Their task was to prospect the route, build snow-cairns every five miles and report any crevassed areas by radio. On Christmas Day the main party of eight vehicles and ten men, carrying a total load of 32 tons, set out to follow the dog teams. Of this load, 22 tons was petrol, half a ton lubricating oil, and one ton tools and spares. The distance to the Pole was 555 statute miles, and we planned to make seismic soundings of the ice depth at intervals not greater than 30 miles. Both at and between these seismic stations, gravity readings were to be made, while regular meteorological records were maintained. In addition, the glaciological work included frequent rammsonde measurements, together with those of ice temperature and density down to 36 ft.

Almost 100 miles ahead the dog party was reporting no crevasses but told us that the going was bad over hard and high *sastrugi*. As we progressed we gradually climbed higher and higher, while across our course extended wave-like ridges at intervals of several miles. The altitude of these varied from 30 ft. to 220 ft., the northern slopes always being steeper and invariably more deeply corrugated by the wind-cut *sastrugi*. But it was not only on the slopes that these *sastrugi*-fields occurred. The most extensive was level and 67 miles wide, with

ridges three to five feet high. Such difficult terrain was very hard on vehicles and sledges, reducing our speed to 2 m.p.h. or less.

For the following weeks until we were within 50 miles of the Pole, where the surface became smoother and softer, the daily events were much the same—long hours slowly grinding over hard *sastrugi*, or through deep soft snow, frequent minor troubles with one or other of the vehicles, time spent every three hours in taking meteorological observations, and the periodic boring of holes for seismic shooting; camping, eating, vehicle maintenance and sleeping had all to be fitted into what hours remained. As a result there was generally very little time for sleep, and at the end of the journey our individual sleep records showed an average of just under six hours per night for each man.

Better weather in the Ross Sea on the other side of the continent allowed Hillary's party to start travelling in early September. At first a number of short journeys were made, and later two major dog-sledge journeys to north and south of the base. Both were most successful in the results that were obtained and the southern proved to be the longest dog journey ever made, the total distance covered being 1,670 miles.

But Hillary's main task was to establish more depots on the high plateau for the crossing party. On 14th October he set out with three companions, in one weasel and three Ferguson tractors. At first there was difficulty owing to mechanical troubles and bad weather, but in 17 days he covered the 290 miles to the Plateau depot, where his party joined up with Miller and Marsh, who were in the early stages of the southern dog journey.

With the dog teams going ahead to warn him of crevassed areas by radio, Hillary was able to avoid the worst of these areas. Nevertheless, they could not hope to avoid all trouble, and from time to time the vehicles broke through the crevasse lids and hung precariously until they could be recovered. On 25th November (the day after we had left Shackleton) Hillary established Depot 480 in position 79° 51′ S., 148° 00′ E. To this point the Beaver flew all the fuel and stores which would be required by the crossing party when they reached this point.

Eleven days later they started south again and, after 130 miles, established the subsidiary Midway Depot. Then the Weasel began to give trouble and had to be abandoned after another ten miles. Pushing on with the three Fergusons they negotiated several crevasse areas, where one vehicle was nearly lost, to reach the site of Depot 700 which had already been selected by the dog party. This was on 15th December. After five days the depot had been built up by air lift and on the 20th Hillary set out on the last 520 miles to the Pole. After two more crevasse belts they were in the clear, with only days of difficult driving over soft surfaces between them and their objective. Finally on 4th January they reached the American Pole station and after a few days rest the Americans flew them back to Scott Base.

Meanwhile Lewis, Haslop, Weston and Williams, who had been left at Shackleton when the crossing party departed, had flown to South Ice on 27th December to await good weather before attempting their flight across the

continent. On 4th January, conditions appeared to be good and they set off. After 300 miles they were forced to turn back in latitude 87° S. by icing conditions and increasing low cloud. Two days later they tried again; this time, passing over the vehicle party and pushing on to the Pole, they headed north down the Beardmore Glacier to reach Scott Base in exactly eleven hours.

As no depots had been established beyond South Ice, the plans for the ground party entailed abandoning vehicles as fuel was consumed and the total load could be carried by fewer sledges. But this meant that the remaining vehicles were operating at nearly full load all the time, while the increasing altitude progressively reduced their developed horsepower. Another disadvantage of abandoning tractors was the reduction of our insurance against the irreparable breakdown of others. Finally there was the mild inconvenience of constantly having to reshuffle the party and their equipment as more men had to be carried in each remaining Weasel or Sno-Cat.

On 31st December we abandoned the first Weasel and, five days later, the Muskeg tractor in latitude 85° 15′ S. From 6th January onwards the dog teams ran with the vehicles, but their presence limited our daily mileage, for we could not expect them to travel more than 30 miles without resting for a night. On the 15th we dropped another Weasel in latitude 88° 03′ S. This left us four Sno-Cats and one Weasel, with which we arrived at the Pole on 20th January, having travelled 930 miles from Shackleton in 57 days.

Until we were 50 miles from the Pole the surface had been undulating and deeply serrated with high *sastrugi*, then it became more even, but also a great deal softer, and our fuel consumption began to rise considerably. At this time each Sno-Cat was travelling only 0.9 miles per gallon instead of the 1.25 miles per gallon that they had maintained previously—an increase of 28 per cent.

We caught our first sight of the Pole when we topped a snow ridge and saw below us, and about seven miles away, a small group of black dots. Normally we would have run straight towards them, but we had been asked to keep clear of the surrounding snowfields which were being studied by the American glaciologists. We therefore ran along the ridge for seven miles to the east, until we could come in on the meridian which had been indicated. As we drove towards the station two Weasels moved out to meet us, and soon we were shaking hands with Hillary, Admiral Dufek in charge of all American Antarctic operations, Lieutenant Houk, administrative Commander of the Pole station, and Major Mogesson, the Chief Scientist. Everyone at the station turned out to see the party arrive and to provide a wonderful welcome. Then we parked our vehicles and went inside to have a very welcome shower and a meal.

Four days later we were away again on the second leg of the journey—1,250 miles to Scott Base. Now the seismic shots were to be spaced more widely, the dogs had been left behind to be flown out by the kindness of the Americans, and soon we should be abandoning the last of the Weasels. All these factors would enable us to travel more quickly.

At first the going was very soft and the route climbed slowly to over 10,000 ft.,

but the depth of ice, which had been 8,000 ft. at the Pole, reduced to 2,000 ft. or less. For 470 miles the way led over an undulating surface which gradually grew harder and here and there bore the remains of giant *sastrugi*. Then, in the last 50 miles before Depot 700 (82° 58′ S., 146° 02′ E., altitude 8,370 ft.), we began again to meet crevasses. These marked the region where the high ice sheet begins to move more rapidly towards the mountains through which it flows as great glaciers. These areas caused us some delay, but by 7th February we reached Depot 700 at last and were able to augment our decreasing fuel supplies.

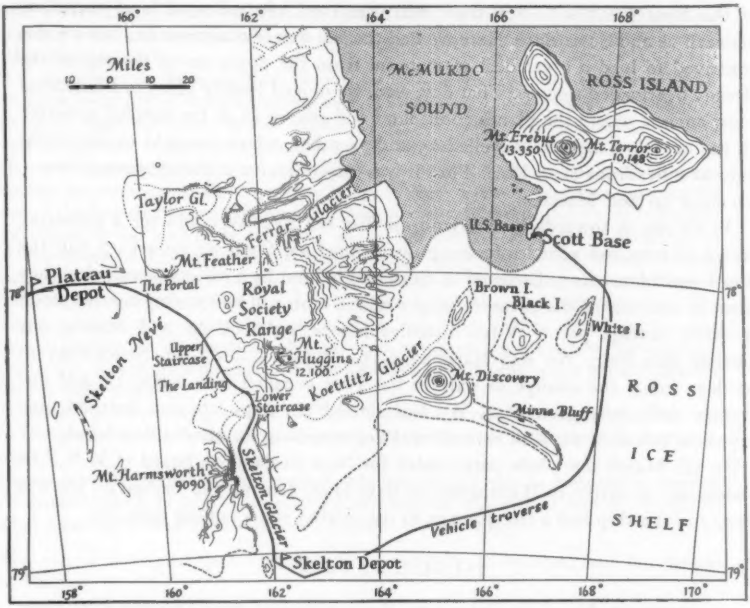
During this stage of the journey Geoffrey Pratt had been found to be suffering from severe cumulative carbon monoxide poisoning and was given emergency oxygen from the welding equipment. But we had insufficient for more than a few hours and I asked Admiral Dufek if he could parachute additional supplies with one of the American long-range aircraft. This he did at a few hours notice and this enabled Pratt to recover completely during the next two days.

At Depot 700 we were joined by Hillary, who was flown to us in the expedition Beaver on 9th February. Next day we set off for Midway Depot, running more or less parallel to the mountains of Victoria Land. The surface became increasingly undulating and it seemed certain that the depressions we were crossing were the upper reaches of glaciers that found their way down through the mountains lying out of sight to the east. Here and there crevasse belts were encountered, but none of them held us up more than temporarily and we reached Midway (81° 30′ S., 146° 09′ E., altitude 7,600 ft.) on 11th February.

Between this point and Depot 480 (79° 51′ S., 146° 00′E., altitude 7,950 ft.) we were increasingly beset with mechanical troubles, for our vehicles had taken a tremendous punishment—welds, steering gear and tracks were all causing anxiety and delays. Fortunately, we had always the spares or the equipment with which to repair the troubles.

For several days before reaching Depot 480 we had been able to use the sun compass, but on leaving that point on the 18th, there was a complete whiteout. We then found that the magnetic compass was so sluggish as to be useless and it became necessary to devise some other means of directing our movement. After some experiment the method adopted was to orientate a line of three stakes and to continue this line by planting more and more stakes from the leading vehicle as it moved forward. To do this the driver had to face backwards and attempt to steer his vehicle parallel to the line of flags extending behind him. The remaining vehicles followed the first, the men on the last one collecting the expended stakes and bringing them forward when necessary. In this way we were able to travel up to 42 miles on a number of days when progress would otherwise have been impossible.

By the 23rd February we had reached the Plateau Depot (78° 01′ S., 158° 25′ E., altitude 827 ft.). To the east lay numerous rocky masses which form the upper part of a great mountain wall falling away to sea level. Through this the Skelton Glacier descends 8,000 ft. to the Ross Ice Shelf. While we were still pitching our tents both the Otter and the Beaver roared overhead before circling to land close beside us. The temperature was −30° F., so the engines were kept



[*Royal Geographical Society*

Route from Plateau Depot to Scott Base

running while we loaded surplus material from the depot into the planes. An hour later they took off again for Scott Base.

That night the seismic gear was laid out for the last time and the final shot was fired the following morning, the 24th February. Then we set off down the Skelton Glacier, the various stages of the route familiar to us under the names given by Hillary's parties—the Portal, the Upper Staircase, the Landing and the Lower Staircase. As we passed down through the Portal, a Katabatic wind whipped up high drift and made driving extremely difficult and forced us to camp after only 15 miles. Next day improved conditions allowed us to travel 52 miles before a 60 m.p.h. wind again prevented further travel. Throughout this time and during the remainder of our descent, Hillary's local knowledge enabled him to guide us clear of all the crevasse zones which had been found on the glacier. In its lower reaches the Skelton was entirely free of snow and the hard green ice allowed the sledges to slide sideways almost beside the vehicles. Then 15 miles before reaching Teale Island and the adjacent Skelton Depot, the surface was more snow covered, but countless barchan-like ridges of drifted snow made driving difficult and prevented us from calling the aircraft in to pick up material we should not require from the depot.

Now we had in fact crossed the continent, for we were at the inland margin

of the Ross Ice Shelf—but there still remained 180 miles of level travelling between us and Scott Base. Here we had the last day of maintenance, but we also contrived to load a great deal of material from the depot on to the top of the already overloaded sledges. That day, also, we moved twenty miles to a smoother snow surface where the planes could land and relieve us of the surplus material. In the next two days we travelled 65 and 75 miles, which brought us to a point only 22 miles from Scott Base. Thus it was easy to arrive at the appointed time—2 o'clock on 2nd March.

As we ran in towards Ross Island on that last day, we could see a gathering crowd of men and vehicles forming up to meet us. Soon we joined up, but the Sno-Cats did not stop. Escorted in front and behind by a variety of vehicles, they wove in and out of the pressure ridges where scores of welcoming figures stood at every vantage point. A few minutes before 2 o'clock on 2nd March, our journey was over. We had travelled 2,158 statute miles from Shackleton in 99 days (98 if the change of date at the Pole is taken into account), and our average daily mileage was 22. We had started ten days late and finished nine days late, but even so, with several weeks of travelling weather still in hand.

On 5th March the whole party sailed for New Zealand on board H.M.N.Z.S. *Endeavour*, to arrive in Wellington 12 days later. During the voyage no ice was seen, and the ship had a free passage to the stormy waters of the open sea.

DISCUSSION

THE CHAIRMAN: May I express to you, Sir, our deepest thanks for this fascinating story retold in an inimitable way, and for making us realize—more perhaps than we had before—the dangers and difficulties of this adventure of yours. And also, perhaps, for making us appreciate that it was not simply a glorious adventure, but also an achievement of tremendous importance for scientific observation and interpretation. We were all quite fascinated by your description of the methods of seismic sounding to determine the depth of the ice, work on the tides under the ice and measurement of gravity near the South Pole.

I hope you will publish your physiological observations in detail; the one that interested me in reading your book confirmed what I might have anticipated—that the playing of darts demanded very little more expenditure of energy than sleep; and I was also greatly struck by the wonderful contributions which must have been made to transport in the cold. I hope they never have to be used, at any rate in this country.

We are, as I am sure you have felt from the volume and intensity of the applause, deeply grateful to you, and you will recognize how much the Society appreciates your visit when I say that there have been many, many applications for seats at this lecture. I believe, Sir, that you will have taken away with you a feeling of the appreciation of the audience and I am merely the instrument of expressing their gratitude to you for your wonderful lecture.

A vote of thanks to the Lecturer was carried with acclamation.

SIR SELWYN SELWYN-CLARKE, K.B.E., C.M.G., M.C. (Chairman, Commonwealth Section Committee): Before the proceedings close may I say firstly how very welcome every member of the audience is to this lecture and to any other organized under the auspices of the Commonwealth Section of the Royal Society of Arts. I should like to

extend a particularly warm welcome to Lady Fuchs, and to Mrs. Runtz, who most generously endowed this lecture as a memorial to her late distinguished husband, Sir Thomas Holland.

It is customary at these meetings to move a vote of thanks to the Chairman. This is no mere formality in the present instance. I know that you will agree that we have been more than fortunate in our choice of Lord Cohen of Birkenhead. We are extremely grateful to him for coming down all the way from Merseyside.

He is, of course, well known nationally and internationally for his valuable contributions to medicine in all its aspects. Some of those present, however, may not be aware of the fact that he was appointed to the consultant staff of the Royal Infirmary at Liverpool at the very early age of 24 and to the post of Professor of Medicine in the University of Liverpool at the astonishingly early age of 34. When he was Chairman of the British Pharmacopoeia Commission some years ago, numbers of my colleagues used to attend the public sessions, which were referred to as 'Sir Henry's postgraduate classes' because of their very high calibre. Realizing his vast store of knowledge on medical and medical administrative matters, government pressed him to accept a peerage, so that the House of Lords could benefit directly from his wise counsels.

With all his outstanding attributes, Lord Cohen is a very human person, and one who inspires sincere affection and deep respect amongst all with whom he comes in contact.

Ladies and Gentlemen, it is my great privilege to ask you to help me to express our warmest thanks to Lord Cohen of Birkenhead for taking the Chair at Sir Vivian Fuchs' memorable and most enjoyable address this evening.

The vote of thanks to the Chairman was carried with acclamation, and the meeting then ended.

THE URANIUM AND THORIUM RESOURCES OF THE COMMONWEALTH

A paper by

S. H. U. BOWIE, B.Sc., M.I.M.M.,

Chief Geologist, Atomic Energy Division, Geological Survey of Great Britain, read to the Commonwealth Section of the Society on Thursday, 23rd April, 1959, with Anton Gray, Senior Mining Adviser, Atomic Energy Authority, in the Chair

THE CHAIRMAN: I am sure that uranium and thorium need very little introduction to this audience. Before the last war they were little known, and apparently unimportant, metals. Their names were probably unknown to most people. Now they are magic words associated with atomic bombs and atomic energy. Uranium is, I believe, the only naturally occurring substance capable of sustaining the self-perpetuating nuclear fission known as a chain reaction. Atoms of this element, we were once taught, were in truth elementary particles of matter, but they have now been demonstrated to be capable of breaking down into smaller particles, releasing, in the process, tremendous amounts of energy. When this reaction is uncontrolled the result is an atomic bomb. Controlled, the energy can be and is being put to useful purposes for generating electricity and for sending submarines under the North Pole.

Both uranium and thorium are extremely important for good or for evil. Much of the knowledge about them has of necessity been kept secret all during the war and since. Not many people know a great deal yet about their occurrences. Mr. Bowie has worked for many years on this problem and is one of the few who do know and who can speak with authority on these occurrences.

The following paper, which was illustrated by lantern slides, was then read.

Introduction

Both uranium and thorium are oxyphile elements. They do not occur in the native state like gold or silver, but form minerals of varying degrees of chemical complexity, all containing oxygen. Oxides, phosphates and niobates, for example, are fairly common, but sulphides, arsenides and tellurides are not known. Geochemically, uranium and thorium are associated with the more acid rocks of the lithosphere, the average content of granites being respectively 3·5 and 13·0 ppm. as compared with 0·8 and 3·1 ppm. for basic igneous rocks.

The grade of raw material that can be worked commercially depends on a number of factors. As a general guide, however, vein deposits require to average

0·2 per cent U_3O_8 and large disseminated deposits 0·1 per cent U_3O_8. As a by-product, uranium is currently being recovered from ore containing as little as 0·01 per cent U_3O_8. Similar values apply for thorium provided a concentrate containing 5 to 6 per cent ThO_2 can be produced at low cost.

Like many other elements, uranium and thorium are concentrated in the earth's crust in provinces where rocks of succeeding ages tend to carry a higher proportion of the elements than is found in other parts of the world. A particularly well-defined uranium province is that of the high plateau country of Colorado, Arizona, New Mexico and Utah, extending northwards to the Dakotas and Montana. Here, abnormally radioactive granites and uraniferous pegmatites of Pre-Cambrian age occur in the Colorado Front Range. Palaeozoic and Mesozoic rocks have concentrations of uranium in phosphorites and black shales. Most of the major deposits of pitchblende and coffinite, together with secondary carnotite, are found in Jurassic to Triassic sandstones and conglomerates. Pitchblende also occurs in Tertiary rocks, for example, at Maryvale, Utah; and concentrations of uranium, which in places run as high as 10 per cent U_3O_8, are to be found in the Cretaceous to Eocene lignites of South Dakota. Similar provinces occur in the shield areas of Canada, South Africa, Australia and India; and it is within these areas that the bulk of the world's reserves of uranium and thorium are to be found.

Current estimates of production and reserves of uranium and thorium in non-Communist countries are given in Tables I and II. The data on reserves indicate that the Commonwealth controls about three-quarters of the resources of both metals.

TABLE I

PRODUCTION AND RESERVES OF URANIUM

Country	1958 *Production* *tons* U_3O_8	*Reserves* *tons* U_3O_8
Canada	13,537	413,000
Union of South Africa ...	6,245	330,000
U.S.A.	12,560	221,000
France	815	50,000
Australia	700	15,000
Belgian Congo	2,123	10,000

No reliable information is available on the production of thorium, but a total of 700 tons ThO_2 is believed to have been produced by non-Communist countries in 1958.

TABLE II

RESERVES OF THORIUM

Country	*Reserves* *tons* ThO_2
India	300,000
Canada	210,000
Brazil	200,000
Australia	50,000
U.S.A.	50,000
South Africa	15,000
West Africa	15,000
Nyasaland	10,000

Thorium is at present mainly used in the production of magnesium-thorium alloys and in the manufacture of thorium nitrate for gas mantles. Some is being used in experimental reactors but as yet there is no great demand for thorium as a fuel element.

Distribution of Uranium and Thorium

CANADA

Uranium. Before the Second World War, the world's annual production of uranium ore was about 30,000 tons and a considerable proportion of this was derived from the only mine then producing in the Commonwealth—the small but rich property of Eldorado, Great Bear Lake, in the North-West Territories. Now, the eleven mills in the Blind River area alone treat 34,800 tons of ore a day.

Uranium deposits in Canada are of three distinct types: vein, disseminated, and pegmatitic. Good examples of vein deposits are those occurring along the St. Louis fault in the Beaverlodge area north of Lake Athabaska. Here, highly metamorphosed Pre-Cambrian rocks of the Canadian Shield have been extensively folded and faulted and uranium mineralization has taken place both along major faults and in shatter zones. At the Ace mine all the known ore occurs within 300 ft. of the fault plane over a strike of 7,000 ft. and to an explored depth of 1,800 ft. The mineralization is of a relatively simple type, pitchblende (Figure 1) and hematite being the only conspicuous ore minerals. The grade of the deposits is relatively high—0·2 to 0·5 per cent U_3O_8—and production from the two mines being worked is about 2,000 tons of ore per day. This tonnage, however, is relatively small when compared with that of the disseminated deposits of the Blind River field on the north shore of Lake Huron.

The Blind River deposits, like those of the Witwatersrand Basin, occur in quartz pebble conglomerates, and, although their average grade is just over 0·1 per cent U_3O_8, they contain vast tonnages of uranium. Recent estimates indicate that this field has reserves of 356 million tons of ore. The ore bodies are elongated or tabular and vary enormously in size. Usually they are about

FIGURE 1. *Pitchblende* (UO_2), *the main ore of uranium*

12 ft. thick but locally they swell to 35 ft. The main uranium-bearing minerals are brannerite and uraninite which occur together with pyrite, hematite and other minerals such as monazite, zircon, rutile, anatase and sphene. The uranium and thorium minerals, unlike those in the vein deposits at Beaverlodge, occur as discrete particles that are too small to be seen with the naked eye, but when concentrated they impart a dark colour to the host rock (Figure 2).

At the present rate of production, four of the mines in the Blind River area have a life in excess of 20 years. One of these, Consolidated Denison, has a capacity of 6,000 tons of ore per day and reserves sufficient for the next 50 to 60 years.

The deposits being worked in the Bancroft area, Ontario, have the distinction of being the only granite pegmatites being worked for uranium in the world. The ore bodies are complex dykes or irregular granitic lenses that cut and replace the country rock. Although they are coarse-grained in places, and hence are termed 'pegmatitic', the grain size is commonly no coarser than that of a granite. At Bancroft the dykes occur as an *en echelon* series in which the ore zones occur as lenses with strike lengths of from 35 to 200 ft., but drilling has shown that vertical continuity is considerably in excess of 900 ft. The dykes are weakly radioactive throughout their length, but the ore zones are less regularly distributed. Uraninite and uranothorite are the principal ore minerals. Other minerals containing uranium and thorium are betafite, allanite, zircon and fergusonite.

FIGURE 2. *Quartzite outcrop near Buckles Shaft, Blind River, Ontario, Canada, showing uranium-bearing horizon (dark)*

Daily production from the four mines in this area is about 3,600 tons of ore averaging about 0·1 per cent U_3O_8.

Thorium. Both the disseminated deposits in the Blind River area and the pegmatitic granite dykes of Bancroft contain appreciable thorium. Reserves are estimated to total some 200,000 tons ThO_2 at an average grade of 0·05 per cent. Assuming a production of uranium oxide of 10,000 tons a year, about 5,000 tons of ThO_2 might be recoverable as a by-product. Thus Canada, in addition to being one of the major uranium-producing countries of the world, is likely to become a major producer of thorium.

UNION OF SOUTH AFRICA

Uranium. Uraninite was first discovered in heavy mineral concentrates from many of the gold mines of the Witwatersrand as early as 1923, but it was not until uranium became valuable as a source of energy that a detailed examination of the banket as a potential source of uranium was undertaken. The uraninite occurs as small grains (averaging about 0·05 mm. in diameter) in association with gold, in relatively thin bands of conglomerate and occasionally in layers of pyritic quartzite. These minerals occur together in the basal portion of the Dominion Reef System, at several horizons in the Witwatersrand System, in the Contact Reef, and in the Black Reef Series, which forms the lowest part of the Transvaal System. The sequence has a total thickness of 25,000 ft. and

includes four major unconformities. Many of the reefs that are economic for gold (for example, the Main Reef Series) have little or no associated uranium, but, in general, there is a sympathetic relationship between gold and uranium. Of the total tonnage of ore treated, approximately 80 per cent is mined chiefly for gold, with uranium as a by-product. The remainder represents low-grade ore in which both metals are equally valuable. The mineral assemblage in the Witwatersrand conglomerates shows a marked similarity to that of Blind River. The ore minerals form the conglomerate matrix and consist mainly of pyrite, gold, pitchblende and hydrocarbon with smaller amounts of copper, cobalt and nickel sulphides and arsenides. Quartz veins cutting the sedimentary rocks carry gold, sulphides, tourmaline and talc.

The grade of the ore averages about 0·025 per cent U_3O_8, though in parts of the Dominion Reef the grade is over 0·2 per cent. Total reserves are estimated to be about 330,000 tons U_3O_8. Of this, some 17,000 tons have been fully developed or blocked out for stoping and a further 5,000 tons are contained in safety pillars, dumps and tailing ponds.

The origin of the mineralization of the Witwatersrand has long been the subject of controversy. Several theories have been advanced, but only two of these have had much support. One is that the gold and uraninite are of direct placer origin, possibly modified by later reworking; the second suggests that the gold, uraninite and most of the other metallic minerals were introduced by hydrothermal solutions.

Arguments advanced to support the placer theory are:

(1) The uraninite occurs frequently as rounded grains in horizons which contain other minerals of undoubted detrital origin.
(2) The distribution of both gold and uraninite is controlled by sedimentary structures.
(3) There is no obvious relationship of the mineralization to fractures or faults.
(4) The widespread nature of the mineralized horizons and separation by barren horizons is difficult to explain on a hydrothermal hypothesis.
(5) The mineralization does not transgress stratification to any great extent.
(6) There is no known magmatic source for hydrothermal solutions.

The main factors in favour of a hydrothermal mode of origin are:

(1) Uraninite is friable and soluble in both acid and alkaline ground waters and as a result does not normally survive as a placer mineral.
(2) Pyrite, gold, and uraninite frequently replace quartz pebbles.
(3) The sequence of deposition of the uraninite, sulphides and gold is typical of hydrothermal vein deposits.
(4) The mineralization occurs in favourable conglomerate horizons where lithological features such as ancient stream channels, lenticular structures and erosional surfaces could have controlled deposition.
(5) Discrete rounded grains of uraninite are typically formed from hydrothermal solutions lean in uranium.

(6) The hydrocarbon is younger than most of the uraninite and the complex formed with uraninite is identical to that occurring in hydrothermal veins.

Knowledge of the mode of origin of the mineralization of the Witwatersrand is not so important in the Witwatersrand Basin itself, where sedimentary features give a guide to the whereabouts of additional ore, but it is of considerable importance in the location of deposits in other parts of the world.

Thorium. Thorium does not occur in appreciable amounts in the Witwatersrand Basin though there are local concentrations in the Dominion Reef, for example to the west of Klerksdorp, where monazite forms up to 8 per cent of the heavy minerals.

The thorium deposit discovered at Steenkampskraal in the western Cape Province in 1949 is of particular interest as it was the first thorium vein deposit to prove of economic value. The ore is a high-grade monazite which replaces hydrothermally altered granite gneiss along a well-marked shear zone. The monazite is accompanied by apatite and zircon as well as coarser copper and iron minerals of a later phase of mineralization. More than 16,000 tons of pure monazite had been produced from this deposit by the end of 1956; and recent estimates indicate ore reserves of some 250,000 tons at a grade between 3 and 6 per cent ThO_2.

Carbonatites in South Africa are sometimes appreciably radioactive and it is possible that the uranothorianite which occurs at Palabora might be recovered as a by-product of copper.

AUSTRALIA

Uranium. Uranium was first produced in Australia at Radium Hill near Olary, South Australia. The deposits were worked on a small scale for radium before the First World War, but it was not until 1944 that full-scale investigations commenced. This study indicated that, although the ore is of low grade and refractory, sufficient ore was available to make the deposit important.

The mineralization occurs in slightly arcuate lodes along a series of parallel fractures and faults, the width of the lodes averaging from 3 to 6 ft., but in places swelling to 12 to 15 ft. The uranium mineral, davidite, occurs intergrown with ilmenite mainly in the central portions of the veins where they are best developed. The associated minerals, felspar, quartz, biotite and hematite have a pegmatite-like character, but the regularity and extent of the ore bodies both laterally and in depth is not typical of normal pegmatites. Production of uranium from the Radium Hill deposits is about 200 tons per annum.

A second type of occurrence in the Australian uranium province that is unique as a uranium producer is the pyrometasomatic deposit of Mary Kathleen (Figure 3), situated halfway between Mount Isa and Cloncurry in north-western Queensland. The deposit was discovered in July, 1954, and production commenced just over four years later. The mineralization consists of uraninite, rare-earth silicates and sulphide minerals occurring in a garnetized zone of calc-silicate rocks of early Pre-Cambrian age. The deposit is clearly related to an

FIGURE 3. *Mary Kathleen prospect and camp, Queensland, Australia* (1955)

intrusive granite mass and is of high-temperature contact-metamorphic origin. The main ore body, which is boat-shaped, is located on the western limb of a regional synclinal structure and its development is apparently controlled by faulting and fracturing. Typical ore consists of dark-brown to black allanite partially or completely replacing a reddish-brown, garnet-diopside granulite containing apatite. The uranium occurs in the form of small discrete grains of uraninite, confined mainly to the allanite. Associated ore minerals are pyrite, pyrrhotite and chalcopyrite.

Uranium is also produced in Northern Territory, particularly in the Rum Jungle area, where mineralization occurs disseminated in carbonaceous slate and graphitic schist.

Australian reserves are estimated to be 15,000 tons of U_3O_8, 10,000 tons of which are in the Mary Kathleen deposit.

Thorium. Australia has reserves of thorium in the large deposits of heavy-mineral sand that occur on the beaches and dunes of south-eastern Queensland and north-eastern New South Wales. These sands are particularly rich in zircon and rutile, which are the main commercial minerals. The thorium-bearing mineral, monazite, averages about 0·3 per cent of the total heavy-mineral fraction and is recovered as a by-product. Production in 1957 amounted to 132 tons of high-grade monazite concentrate. The thoria content of the monazite ranges from 6·3 to 7·4 per cent, averaging about 6·6 per cent.

INDIA

Uranium. Recent investigations undertaken by the Indian Department of Atomic Energy have revealed extensive uranium mineralization in the Singhbhum copper belt, Bihar State. Two large ore bodies have so far been located and in systematic diamond drilling at one of them—the Jaduguda deposit—over a million tons of ore have been indicated. The grade is low, averaging between 0·05 and 0·1 per cent U_3O_8 in the horizons so far drilled, but there are indications of ore of a grade of 0·15 per cent in some of the deeper holes.

The uranium occurs in disseminated uraninite associated with conglomerate horizons and with apatite-magnetite bands and rocks rich in tourmaline, chlorite and biotite. The location of the ore is controlled by fracture and shear planes which have afforded easy access to the mineralizing solutions.

Thorium. Important new discoveries of very large placer deposits containing monazite have also been made recently over an extensive inland area of Bihar and West Bengal. The mineralized region covers a series of peneplanes on the north-eastern flank of the Indian shield, and although the average content of heavy minerals is only 2 to 4 per cent, roughly a quarter of the total heavies is monazite. In an initial test area covering 130 square miles it is estimated that 34,800 tons of monazite occur per square mile over an average thickness of just less than 3 ft. Associated heavy minerals, roughly in order of abundance, are ilmenite, sillimanite, zircon, magnetite, rutile, columbite-tantalite and apatite.

The monazite deposits associated with ilmenite along the south-west coast of India, including the commercial deposits of Chavara and Manavalakurichi in Kerala and Madras States, are known to most geologists. The monazite in these deposits has a fairly high ThO_2 content, usually between 7·5 and 9·5 per cent, while the U_3O_8 content is about 0·3 to 0·4 per cent. Shallow bore-holes put down through the beach indicate that the heavy minerals persist to a depth 24 ft., though the concentration decreases somewhat in depth. Sixteen occurrences covering an area of 3,000 acres have been sampled and the quantities of monazite available to an average depth of about 20 ft. are estimated to be 1·4 m. tons. Considerable amounts of monazite also occur in lake deposits and sand dunes as well as in heavy sands up to a mile off shore, but the reserves in these have not yet been assessed.

NEW ZEALAND

A small occurrence of uranium was discovered in the Buller Gorge, South Island, New Zealand, in 1955 and subsequent exploration in the area revealed the presence of fairly extensive disseminated deposits similar in type to some of the primary deposits of the Colorado Plateau. At least ten horizons are known, ranging in width from a few inches to several feet. The mineralization is patchy along the outcrop examined, varying from less than 0·025 to 6·4 per cent U_3O_8, but it may well be that reserves at a mineable grade are of the order of several thousand tons of U_3O_8. The bulk of the uranium is contained in the mineral coffinite which occurs as fine dispersions along with pyrite, dolomite and hematite.

FIGURE 4. *Uranium treatment plant, Virginia Mine, Orange Free State, South Africa*

FEDERATION OF RHODESIA AND NYASALAND

Uranium. In 1952, in the Mindola section of the Nkana mine, a significant discovery of uranium ore was made in the 'No. 4 shaft barren gap', where earlier development had shown the sandy dolomitic ore shales to become unpayable for copper. The host rock is composed largely of a mosaic of cryptocrystalline quartz and felspar with muscovite and a yellow magnesium-rich biotite. Calcite and dolomite also occur interstitially. Pitchblende, which is the main uranium ore mineral, occurs finely disseminated throughout favourable horizons as interstitial grains less than 0·5 mm. across. Coffinite is sometimes present in association with pitchblende and albite-calcite veins carry brannerite and anatase with minor amounts of uraninite. Non-radioactive minerals present in the ore horizons are mainly copper and iron sulphides.

Production of U_3O_8 in 1958 at Mindola amounted to 44 tons.

No large source of uranium has yet been found in Southern Rhodesia. Pitchblende occurs in tight veinlets and stringers in epidiorites in the Mpudzi River basin near Umtali, and some ore has recently been produced from this source; but reserves are not large. The deposit is of geological interest because of the development of the secondary uranium minerals kasolite, uranophane and fourmarierite, the latter previously being known only at Shinkolobwe.

Thorium. Important reserves of monazite occur in Nyasaland along the west shore of Lake Nyasa, particularly in the Monkey Bay region. At least three

deposits here are large enough to be of commercial value. The monazite occurs in fine-grained consolidated sand in raised beaches near the present shore line, and has a ThO_2 content of just over 7 per cent. Associated minerals are magnetite, ilmenite, garnet and zircon. More extensive deposits containing monazite also occur on the east shores of the Lake. The thoria content of this monazite, however, is only about 4·5 per cent—a grade which is not at present acceptable commercially.

Pyrochlore from the carbonatite complex at Nkombwa Hill is fairly rich in both uranium and thorium. Analysis of selected concentrates indicate about 2 per cent U_3O_8 and 0·5 per cent ThO_2.

EAST AFRICA

Several of the carbonatite complexes discovered in recent years in East Africa contain thorium in pyrochlore and monazite. None of these deposits is rich enough to be worked for thorium, but the element could be recovered as a by-product of niobium at some of the localities. Examples of carbonatites with appreciable thorium reserves are Sukulu (Uganda), Mrima (Kenya) and Mbeya (Tanganyika). At Sukulu pyrochlore in soils contains about 2 per cent ThO_2. Pyrochlore from Mrima contains 2 to 3 per cent thoria, while the monazite contains somewhat less than 1 per cent. Mbeya pyrochlore contains about 1·7 per cent ThO_2.

WEST AFRICA

Monazite and thorite occur in the placer tin fields of Nigeria in considerable amounts and can be recovered comparatively easily as a by-product of cassiterite. Reserves contained in ore which is likely to be mined over the next 20 years amount to over 2,000 tons of ThO_2. The thorite, which contains up to 56 per cent ThO_2, is normally produced in concentrates containing 5 to 6 per cent ThO_2; and the monazite, which contains about 6–8 per cent ThO_2, is concentrated to a similar grade. By-product thorite is also obtained from the weathered portions of the Rayfield-Gona granites, at present being worked as a source of niobium. Production in 1957 totalled 93 tons and 1,054 tons of monazite and thorite concentrates respectively.

CEYLON

There are numerous small but rich heavy mineral deposits on beaches on the west coast of Ceylon and at Pulmoddai in the north-east of the island. The monazite from these localities carries about 9 per cent ThO_2 and production at present is over 100 tons of concentrate per annum.

MALAYA

Malaya, like Nigeria, has an important potential source of thorium as a by-product of tin. No detailed assessment of the field has yet been undertaken, but production in recent years has averaged over 400 tons of monazite, and could be maintained at this level for many years.

Conclusions

This brief review of the geology and mineralogy of some of the more important uranium and thorium deposits, together with output data and estimated reserves, gives an indication of the vast potential of the British Commonwealth as a producer of the raw materials of atomic energy. Many more areas rich in uranium undoubtedly exist, but whether there are many more as large and as rich as Blind River, or from which uranium can be produced as a by-product of some other metal, as in the Witwatersrand Basin, is not so certain. In addition to these two major fields, the Copper Belt of Northern Rhodesia probably offers most hope as a future large-scale supplier of uranium, while the Blind River field and the placer deposits of India will produce the bulk of the world's thorium.

DISCUSSION

THE CHAIRMAN: I do not know how many people realize it, but this is something of an occasion. I think this must be one of the first times in history, certainly in this part of the world, when a public audience has been privileged to hear the kind of information and the figures that Mr. Bowie has given you this evening. I can assure you that if I had got up in public even a couple of years ago and given you this information, I should have gone to gaol for ten years!

MR. P. K. SHAHANI: The lecture has been very interesting, but I did not hear any thing about thorium in Malaya. Could Mr. Bowie say something now? Secondly, Mr. Bowie said that the secondary uranium minerals occur in Jurassic and Triassic rocks. Now apparently most of the Jurassic and Triassic rocks are not on land, but beneath the ocean beds, the Atlantic and Pacific, for example. I wonder whether the lecturer considers that there should be more research into marine geology than into land geology in order to find out the further resources of uranium deposits? And I wonder if there has been any such research before, and whether within the twelve-mile sea limit of the Commonwealth countries there would be ample uranium resources or not?

THE LECTURER: I mentioned thorium in Malaya and gave you the data on production. I also said that the reserves were not known, as little work has yet been done in the Malayan Peninsula.

Primary, as well as secondary, uranium minerals occur in the Jurassic-Triassic rocks of the Colorado Plateau and it is possible that deposits occur in similar rocks under the sea. I do not consider, however, that it would be a very remunerative project to attempt to prospect for uranium on the ocean floor. There is considerable evidence indicating that the uranium was introduced into the sediments of the Colorado Plateau mainly in areas of uplift associated with igneous activity, but no evidence to suggest that Jurassic and Triassic rocks elsewhere in the world have a higher than average uranium content.

DR. F. DIXEY (Director of Overseas Geological Surveys): I should like to congratulate Mr. Bowie on his extremely interesting and informative address. As the Chairman mentioned, no one else has been in quite the same strong position to give such an address, and we have been much privileged to hear it. Mr. Bowie has, of course, been dealing with the Commonwealth territories, and if I might distinguish for a moment between the Commonwealth and Overseas—or former Colonial Office—territories,

I should like to say with regard to the latter that Mr. Bowie has been a frequent and welcome visitor in those territories. He has assisted in the investigation of occurrences of radioactive minerals, and he has described them in collaboration with the local Geological Surveys, which have greatly appreciated the work that he and his staff have done in this direction.

He showed us the Canadian Shield and the important deposits there and the extent of new ones probably extending into the North-Eastern area and into Greenland, and he has also dealt with the African Shield and referred to the Copper Belt uranium deposits. So far, the African Shield has been disappointing in relation to other deposits of this kind, and I wonder whether Mr. Bowie is in a position to say anything on perhaps a long-term basis with regard to the possibility of production from certain of the alkaline granites or syenites of Nyasaland, Nigeria, etc., that are known to constitute low-grade uranium deposits? If he felt in a position to say anything on that score, with regard to that particular shield, it would be of interest.

THE LECTURER: So far as we know at present, in the type of mineralization which occurs in the alkaline granites of Africa, both uranium and thorium occur in refractory minerals—that is, in minerals which are not easily leachable with dilute sulphuric acid—and I think that, although there is a potential source in such granites, this is a source of the distant future, rather than of the near future. I specifically mentioned the Copper Belt because I think that on the grounds of the general geology and geochemistry of the area one would expect to find extensive deposits of uranium, in the form of pitchblende, and brannerite and possibly coffinite. I think the reason why we have not found more than we have in the Copper Belt is because nearly all the work there has been done with a view to discovering copper, and you will remember I said that the uranium which we expect to exist probably occurs in what is known as the barren horizons or so-called 'barren gaps' between the places where copper is well developed. I think it is here that prospecting, and possibly drilling, may produce results.

MR. C. B. CAMPBELL: In the early part of the lecture a map was shown which displayed the distribution of uranium deposits in the world, and Mr. Bowie mentioned their association with the shield areas. As a result of the discoveries over the last ten years would he say that the distribution follows the peripheries of the shields or ranges over the whole extent, and if the former case applies, whether there are indications of the distribution of uranium sources in the long term as between have and have not nations in the world?

THE LECTURER: The evidence of recent years has certainly shown a link between the occurrence of uranium and the shield areas of the world. It has been suggested by some geologists that uranium occurs in the margins of the shields. There is really no evidence, in my opinion, on which to base this except in Canada, where the main occurrences are on the western and southern margins of the shield. This, I think, is mainly due to the fact that these parts of Canada have been developed more than the inner parts of the shield area, and I feel that it is quite likely that uranium deposits will be found throughout the shield areas, both in Canada and elsewhere, once these parts have been developed.

I would answer the second part of the question by saying that there is a general association of uranium with the shield areas, but that the countries with the largest reserves of uranium will probably prove to be those that cover the largest areas.

SIR SELWYN SELWYN-CLARKE, K.B.E., C.M.G., M.C. (Chairman, Commonwealth Section Committee): I am one of those who has been slightly 'airborne', especially by the use of the words 'shield' and 'horizon' in this connotation, which is unfamiliar to me. Like the previous speakeis I have greatly enjoyed Mr. Bowie's survey of radio-

active substances in the Commonwealth. He may regard my question as being a little outside his terms of reference for this particular lecture—I am, however, very interested in the accounts we have received in this country of the ill-effects on workers mining these radioactive substances. I think everybody is familiar with the mines in Czechoslovakia, which have a particularly bad reputation in this respect. I wonder whether our speaker can tell us what precautions, if any, can be taken to avoid the hazards of ionizing radiations amongst those mining these valuable ores?

THE LECTURER: Every precaution is now being taken in the mining of uranium. It has been shown that the ill-effects you speak of have been caused mainly by the gas, radon, given off by the uranium, and this can be controlled in mining by increasing the ventilation, and by keeping the radon content of the mine below a tolerance level. Nearly all operating mines throughout the world now have radon monitors installed, so that the air is checked daily. I think that in this way any occupational hazards are removed.

PROFESSOR D. WILLIAMS (Geology Department, Imperial College): My first question relates, as Mr. Bowie might have anticipated, to the origin of the uraninite in the Witwatersrand. He has given us six arguments in favour of its placer origin, and six in support of its hydrothermal derivation, but has refrained from committing himself to either hypothesis. I wonder if he would care to tell us which of the two he really favours? Secondly, does he envisage that there will be a vigorous resumption of uranium prospecting during the next decade after the present lull, and if so, does he consider that there is a likelihood that the application of improved airborne radiometric and geochemical prospecting techniques will lead to many new discoveries of ore?

Finally, the lecturer showed a map of the world distribution of uranium and thorium, and to the east of the Iron Curtain there was a great extent of 'white', relieved only by a single uraniferous area in South Siberia. Does that blank really represent a dearth of uranium in the U.S.S.R., or does it merely indicate our ignorance of Russian resources?

THE LECTURER: To start at the end, I would say quite definitely that that whiteness is due to ignorance of what is produced in the U.S.S.R. and of what the reserves of the U.S.S.R. are.

In my opinion it is likely that further prospecting for uranium will be undertaken and that geochemical techniques already used will be improved. There are also developments going ahead in the field of airborne techniques, mainly using a spectrometer, which will differentiate between radioactivity due to thorium and radioactivity due to the uranium. On the question of the origin of the Witwatersrand, I have presented to you as fairly as possible the argument for and against the placer theory and the hydrothermal theory: I am neither a confirmed placerist nor a confirmed hydrothermalist, but at present my view is that the uranium and gold were introduced into the sediments from an external source. If somebody can prove to me that that is wrong, I am quite prepared to change my mind.

DR. R. W. R. RUTLAND (University College): I should like to add one further question to Mr. Campbell's remarks concerning the spatial relation of uranium deposits to the pre-Cambrian shields. I wonder if Mr. Bowie has any view as to the relations of the post-Cambrian Colorado field to the Laurentian Shield. Is it a lateral or a vertical relation, denudational or structural; or does he think that the Colorado field is an exception to the general rule?

THE LECTURER: Pre-Cambrian rocks certainly lie below the sandstones of the Colorado Plateau, and it has been suggested that the uranium in the sandstones was derived from the underlying pre-Cambrian rocks.

All the deposits of uranium do not lie within pre-Cambrian rocks on shield edges.

There are many deposits in younger rocks. If you look at this from a purely lay point of view, the time during which mineralization could have taken place in the pre-Cambrian is something like ten times that of the rest of the geological time, and I would say, therefore, that there is ten times more chance of finding uranium in pre-Cambrian rocks than there is of finding it in rocks of younger age.

THE CHAIRMAN: Might I just add to the answer to Sir Selwyn Selwyn-Clarke's question? At Shinkolobwe in the Belgian Congo, where radium ore was mined for some twenty years before the uranium boom started, not a single case of illness through working underground was discovered when thorough checks were commenced. So I do not think that there is any great hazard in working underground in a modern mine, which is usually well ventilated.

It only remains for me to thank Mr. Bowie—and I am sure everyone here will wish to be associated with me in this—for a very interesting and, I can assure you, a very authentic address.

A vote of thanks to the Lecturer was carried with acclamation.

SIR SELWYN SELWYN-CLARKE: Before we go, I should like to thank our Chairman for presiding so admirably this afternoon. We are very lucky in having Mr. Anton Gray. I believe I am right in saying that he was bred and brought up in the uranium country—at least I know he went to the Universities of Arizona and Minnesota, and if you draw a line between those two I think you will probably hit that very clouded area with all the numbers on, which we saw on the lantern slide!

A vote of thanks to the Chairman was carried with acclamation, and the meeting then ended.

GENERAL NOTES

LEGAL PROTECTION OF INDUSTRIAL DESIGNS

The President of the Board of Trade has appointed a Committee under the Chairmanship of Mr. Kenneth Johnston, Q.C., 'to consider and report whether any, and if so what, changes are desirable in the law relating to the protection of industrial designs. In framing their recommendations the Committee should include consideration of the desirability of enabling United Kingdom designs to receive cheap and effective protection in other countries on the basis of reciprocity'.

The Committee would welcome the submission of views or comments on the following topics, either in support of the present law relating to industrial designs, or with a view to making changes in it:

1. The definition of a 'design'.
2. The problems which arise when a design is dictated by the function of the article to which it is applied.
3. The extent to which it is in practice difficult for any type of article bearing a design, as defined in the Designs Act, 1949, and having some degree of novelty, to obtain any, or any effective, protection.
4. The prerequisites of protection : must protected designs be new or should they be original in the sense that they must be the original work of the author.
5. The extent of the right given by registration : should registration confer an absolute monopoly in the design and insubstantial variance of the design or should it confer protection only against copying ? What safeguards should there be (if any) to protect tradesman marketing infringing articles ?
6. The period of protection.
7. The protection of the public against abuse of the monopoly rights given in an industrial design.
8. Registration and marking requirements.
9. Provisions for withholding certain designs from public inspection.

10. The inter-action between industrial designs protection and protection under the Copyright Act, 1956.
11. International protection of designs.

Fellows of the Society who wish to submit suggestions or give evidence upon any of these matters are invited to communicate with the Joint Secretaries, The Designs Committee, The Patent Office, 25 Southampton Buildings, London, W.C.2.

NEW TREASURY AT LINCOLN CATHEDRAL

The Worshipful Company of Goldsmiths are sponsoring a most interesting venture at Lincoln Cathedral. The Dean and Chapter have made available a room, variously known as the Dean's, St. Hugh's, and the Medicine Chapel, which is now being converted for use as a Treasury to the designs of Mr. Louis Osman. This Treasury, probably the first to be opened in an Anglican church in England since the Reformation, is expected to be ready for public inspection in April, 1960. It will contain, in showcases and shelves, some 60 pieces of plate borrowed from churches in the diocese of Lincoln. Exhibits will be changed from time to time, and the selection will be confined to plate which is either temporarily or permanently not in use in its parish. The Lincoln scheme will thus draw the attention of both the general public and members of the parishes themselves to the existence of these rare and beautiful objects, which in many cases lie unseen, and sometimes forgotten. It will also add to the significance, both spiritual and artistic, of the Cathedral, and—if successful—possibly inspire other cathedrals to emulation.

A. E. HOUSMAN CENTENARY EXHIBITION

The centenary of the birth (26th March, 1859) of A. E. Housman is commemorated in an exhibition of manuscripts, books, letters and memorabilia which opens on 31st August at University College, London, where he was Professor of Poetry from 1892–1911. Mr. John Carter has arranged and catalogued the exhibition, which includes Housman's own copy of the first edition of *Last Poems*, the original manuscript of his first known poem, 'Sir Walter Raleigh' (1873), and three sheets from his poetical notebooks which have not hitherto been publicly seen in this country and have been lent for the occasion by the Library of Congress, Washington.

There is no charge for admission to the exhibition, which may be seen in the Flaxman Gallery of University College Library, Gower Street, W.C.1, on all weekdays except Saturdays, from 10 a.m. to 5 p.m., until 25th September

TWO CENTURIES OF BRITISH SHIPPING

An exhibition of paintings and prints of ships and the sea, lent from the offices of British shipping companies, is being shown at the Art Gallery of the Commonwealth Institute, South Kensington, until 27th September. The exhibition's main theme is the part played by British maritime enterprise in the development of shipping and the Commonwealth, and it provides an opportunity for seeing a number of interesting pictures which are normally inaccessible to the public. The hours of viewing are from 10 a.m. to 4.30 p.m. on weekdays, and from 2.30 to 6 p.m. on Sundays.

OBITUARY

COLONEL W. J. BROWN

Colonel Walter James Brown, V.D., LL.D., J.P., who died at his home in London, Ontario, on 18th July, aged 86, had been a Vice-President of the Society since 1957, and its Honorary Corresponding Member for over twenty years.

The keystone of Colonel Brown's busy and full life was service to his country and fellow men: whether in the military sphere, in adult education, in social welfare

or in university administration he gave of his imaginative and energetic best. He was born in Aylmer, Ontario, and educated at the Ontario Agricultural College, the University of Toronto and the Chicago Law School. This dual strain, of the theoretical and practical, in his training partly explains the versatility and adaptability which were always his; and academically speaking, it bore fruit in the Soldiers' Land Settlement Scheme which he drafted for the Dominion Parliament in 1919. His own association with the armed forces, which began in 1891 when he entered the active Canadian Militia, maintained its importance for him until the end of his life. His youth, however, was variously spent. For several years at the turn of the century he was engaged in social survey work in the southern United States. Returning to Canada, he became Secretary of the National Sanatorium Association, and subsequently a staff writer on the Toronto *Globe*.

During the First World War his special knowledge of gunnery was put to valuable use: he recruited, and commanded in the field, the 4th Brigade of the Canadian Field Artillery. In 1921 he was appointed Executive Secretary and Lecturer in Social Science (later he became successively Director of Extension and Adult Education, and Bursar) at the University of Western Ontario. Here he found not only scope for his military interests—particularly as officer commanding the University's O.T.C.—but opportunities to share in the organization of local affairs. For a number of years he was Chairman of the Community Planning and Development Committee for London (Ontario), and President of the London and District Branch of the Chartered Institute of Secretaries. In 1955 he was the first person in Canada to receive the 'Distinguished Professional Service Award' from that Institute. Two further honours, both richly deserved, graced his last years. In 1954 the honorary degree of LL.D. was conferred upon him by the University of Western Ontario, to the extra-mural development of which he had so greatly contributed, and in 1957 his many services to the Royal Society of Arts were recognized by his appointment as the Society's first overseas Vice-President and Member of Council, a step which required a special amendment of the Bye-Laws to make it possible.

Colonel Brown's devotion to the R.S.A. was constant and sincere, and his death will be felt throughout Canada. Recent developments of the Society's activity in that country owe much to his thought and initiative, and will be both an enduring testimony to his wise fathering of the Society's interests there and a solid basis for their future expansion.

A few weeks before his death Colonel Brown received an invitation to attend, as a Vice-President of the Society, the presentation of the Albert Medal to the Governor-General by His Royal Highness the President. His doctors were adamant, and refused to let him travel to Ottawa, but the invitation in itself must have been to him—as his friends and colleagues certainly recognized it to be—the most gratifying acknowledgement possible of his long and devoted work for the Society.

MR. J. H. HYDE

Mr. James Hazen Hyde, the American benefactor and Francophile, died at Saratoga Springs, New York, on 26th July, aged 83. He was one of the six Honorary Life Fellows of the Society, having been elected to this distinction in 1927 in recognition of the generous support which he gave to the Fund for the Preservation of Ancient Cottages.

Hyde's father, James Baldwin Hyde, was the founder, just a century ago, of the Equitable Life Assurance Society of the United States, and after leaving Harvard he himself was for some years a Vice-President of the company. By temperament, however, he was not well suited to the exigencies of business life. An imaginatively conceived and necessarily lavish ball which he held in New York in 1905 received sensational publicity and was followed by political repercussions, with the result

that he resigned his Vice-Presidency, sold all his company holdings, and went to settle, happily, in Paris. Decidedly a man of fashion, in a sense little appreciated to-day, Hyde took an informed delight in French civilization which found expression in patronage of art and letters; in alliance with his agreeable manners this disposition made him a cherished figure in the life of the city. His riches were employed in public as well as in private causes. Always liberal and eager in encouraging closer Franco-American cultural relations, he was closely associated with several movements directed to that end, both in France and the United States. In addition to honorary degrees bestowed on him by universities in both countries, Mr. Hyde's devotion to this work was rewarded by two marks of esteem which he especially prized: the award of the Grand Cross of the Legion of Honour, and election to membership of the French Academy of Moral and Political Sciences.

SIR WILLIAM MCCALLUM

Sir William Alexander McCallum, K.B.E., who died in Caracas on 22nd July, at the age of 76, was for many years a well-known figure in the business and public life of Argentina. A native of Glasgow, and educated at the Royal Technical College there, and at the Institute of Technology, Manchester, he first went out to Buenos Aires in 1909. In 1911 he was appointed resident director of the British Structural Steel Co., Ltd., for which he worked during the rest of his professional life, being managing director from 1923–49. He was twice chairman of the British Chamber of Commerce in Argentina, and during the recent war was chairman of the British Community Council. Sir William McCallum, who was made K.B.E. in 1941, was elected a Fellow of the Society in 1951.

NOTES ON BOOKS

ENGLISH ART 1800–1870. *By T. S. R. Boase (The Oxford History of English Art, Vol. X.) Oxford, Clarendon Press,* 1959. *50s net*

The seventy years covered by this book are among the most varied and significant in the history of English art. At the beginning of the century a new generation of artists was coming to the fore, the first to have been trained in the main under the aegis of the Royal Academy, and the efforts of that institution to found a national school were to be tested by the performance of these men. At the same time the rapid rise in population and prosperity led to a considerable increase in patronage for the arts, not always wisely bestowed. Never was English art more isolated from movements on the Continent. If the high hopes of the Academy were not to be entirely fulfilled, this was not attributable either to shortage of patronage, to lack of self-confidence, or to the absence of new ideas. The period saw the Classical style succumb to the Gothic, the floraison and decline of water-colour painting, the rise and fall of naturalistic landscape, the vogue for Pre-Raphaelism, and a growing disposition on the part of the Government to undertake training and give commissions for the arts and crafts.

Yet, with the exception of certain special subjects (such as architecture) and the work of the most prominent artists, the wealth of material produced in this period has not been studied at all closely in systematic fashion. For many artists who must be considered in any history of the times the main sources of information remain biographies or autobiographies published shortly after their deaths, contemporary journals, museum catalogues, and even Parliamentary Papers. The art-historian who sets out to give a synoptic account of the period has accordingly to do an inordinate amount of delving into primary sources to acquire the facts and the knowledge of tendencies on which he is to form his judgements. This arduous task

Mr. Boase has performed most successfully, with a keen eye for the essential, and a sang-froid which conceals the labours underlying his account. His book is easily written, and the narrative remains constantly interesting, while the necessary core of references to other literature is provided by a judicious use of footnotes. The usefulness of the survey is much enhanced by the excellence of the index and the bibliography.

Mr. Boase has wisely taken the taste of his period as one of the guiding lines of his survey, rather than the more partial assessments which might be suggested by a complete reliance on current fashion. In this way he has been able to present the complex story in a unified form. It is a great achievement to have done so with such economy of means, not only for the painting, but also for the architecture, sculpture and decorative arts which bulk with almost equal importance at this time. The choice of illustrations follows the same plan as the text in laying emphasis on the works most praised in their own day. Thus they include much that is unfamiliar or virtually unknown—such as Haydon's *Nero harping while Rome burned*, in a private collection in Melbourne, and West's *Death on the pale Horse* in the Pennsylvania Academy of the Fine Arts. A number of illuminating juxtapositions have also been arranged, as for example, the paintings of the Holy Family by Herbert and Millais, reproduced on the same plate.

The very variety of the painting in these decades ensures that future generations of art-historians will do much detailed work on it; but the main lines are unlikely to be substantially altered from those of Mr. Boase's sketch. He has in particular enriched our knowledge on some special aspects; for instance, the competition held in 1843 in connection with decorating the new Houses of Parliament. Though the final products of this competition and the resulting fresco paintings hardly justified the time and labour spent upon them, they are characteristic of one side of English art, and form the last ambitious attempt made here to naturalize a school of historical painting.

Some of the more informal painters—whose contributions are sometimes of more lasting interest than those of the academic artists—get short shrift; for instance, Frith appears only in a footnote, J. C. Hook not at all. But in so compressed a study it is more remarkable that so much should have been included than that some omissions can be detected. And when Mr. Boase writes of the really outstanding masters, such as Constable and Turner, he has been able to throw new light on familiar places by the freshness and vigour of his judgements. This volume amply carries out the aims of the Oxford History of English Art, of which the author is editor.

GRAHAM REYNOLDS

THE EARLY SCULPTURE OF ELY CATHEDRAL. *By George Zarnecki. London, Tiranti*, 1958. 18*s net*

Stone sculpture in medieval England rarely took the form of the complicated didactic programmes with numerous scenes and figures of which so many examples are known from France. Tombs apart, it was usually a straightforward architectural enrichment and it was particularly favoured in the twelfth century before the designers of Early English mouldings had found a more economical method of producing an elaborate interplay of light and shade. There is a preponderance of geometrical and floral motives, usually in some sense of ultimate classical origin but transmitted through the minor arts, not through architectural tradition. Of these arts the most influential was probably goldsmith's work, but similar motives were used in the decoration of manuscripts; and since the latter, unlike objects in precious metals, have tended to survive, they give the most useful pointers to the motives' history.

In Anglo-Saxon England, and in Normandy itself before 1066, this kind of

decoration was for the most part confined to capitals, and in England the same remains true to the end of the eleventh century. Its extension to the jambs, tympana and surrounds of doorways is a continental development whose origins are unclear and (owing to the doubtful date of most of the monuments) are the subject of constant specialist debate. As far as England is concerned, one of the principal sources of inspiration was, however, certainly Italy, and this is particularly well illustrated by the three splendid doorways opening on to the cloister at Ely.

Dr. Zarnecki's book sets out first of all to provide adequate illustration of all the Romanesque stone carving which Ely can still show. The plates are amazingly good and, as far as lesser items such as the capitals of the transept are concerned, are liable to be the only accessible reproductions which exist. Of the corbels under the eaves only a few are reproduced; but this is not of much consequence as they are merely a series of grotesque heads and, like all sculpture in exposed places, certainly include a fair proportion of replacements. Illustrations of related sculpture elsewhere and of relevant drawings from manuscripts round off the whole.

The plates are accompanied by a masterly disquisition on the stylistic background and date of the various groups into which the sculptures can be divided. The three doorways are apparently all from the hand of the same man who also decorated some originally plain capitals in the transept galleries, and who was at work in the 1130s. The sculptor concerned seems also to have worked at Norwich. His style and ornament are in an English tradition, rooted in pre-conquest art, but he had some knowledge, probably from sketches, of contemporary work in North Italy. An earlier group represented by capitals in the lower storey of the south transept and assigned to *c.* 1090 shows a fusion of Norman and English elements. Gratifyingly, but not surprisingly, works closely related to both groups can be found in places at some distance from Ely but near to where the stone used was quarried. There is a brief note on the curious tombstone of a bishop, apparently Tournai work, of the mid-twelfth century.

This is one of those exceptionally satisfying books in which the author has been able to treat and illustrate his theme comprehensively. The subject matter is particularly interesting, the objects are themselves beautiful, and (a thing unusual in works on medieval art) a clear picture of actual men doing actual work emerges from it.

CHRISTOPHER HOHLER

PIONEER RESEARCH ON THE ATOM. *The Life Story of Frederick Soddy, M.A., Ll.D., F.R.S., Nobel Laureate. By Muriel Howorth.* London, New World Publications, 1958. £3 15*s net*

Few people are privileged to have their biographies written while they are alive unless they undertake the task themselves. They are, however, then able to check the factual accuracy of the account and probably to choose the approach most agreeable to them. If the record is deferred until an historically appreciable time after the death of the subject, factual accuracy may suffer for lack of data, but a more accurate assessment against the contemporary background becomes possible. Mrs. Howorth's task in describing the life and assessing the character of Frederick Soddy was made difficult by the fact that the record was begun during his lifetime and with his cognizance and co-operation, but was by no means complete at the time of his death, when a mass of documentary evidence became available to the biographer, but the personal recollection and reminiscences abruptly ceased.

There is, however, enough of Soddy's personal contribution in the book to set his picture in a proper light. To those who knew him well the many familiar characteristics, the penetrating comment, the curious contrast of reticence and self-confident expression, the lucid exposition of one intricate problem alongside the tortuous

mental analysis of another, all play their part in building up what must have been one of the most complex characters of our time. Every facet of that character is revealed in a striking manner by simple narrative or telling anecdote, by quotations from Soddy's own letters and papers or by the comments of his friends, sometimes even by reference to those who were not so friendly. What puzzled his acquaintances most of all, perhaps, was the way in which his outlook and even his personality seemed to change just at the time when he appeared to have an unassailable scientific reputation with enormous possibilities ahead of him. It can be argued that the war of 1914–18 was responsible for a great disillusionment, or that a return to his own old University proved a great disappointment to him, but the reasons for the undoubted change were probably more numerous than these and more complex than either of them. Mrs. Howorth's tireless researches into Soddy's publications and correspondence coupled with the conversations which she had with him in the later years of his life have gone far to solve this difficult problem.

It is clear from the account of his life as given in this book that although there were many times when Soddy was finding life enjoyable, stimulating and in every way worth living, he had in him from earliest childhood all the elements of a rebel, and that while he accepted convention so long as it did not appear to him to conceal truth or contradict right principles, he was always prepared to fight it if it did. As Professor Feather has pointed out in a broadcast talk, the astounding success of the disintegration theory put forward by Rutherford and Soddy when they were both only on the threshold of their scientific careers has made it almost impossible for those who have come after to realize what a revolutionary act it was. After such a brilliant achievement in scientific rebellion, the failure to bring about the economic and moral revolution which he felt was necessary for the safety of mankind must have been a bitter pill to swallow. For Soddy, probably alone of all people in those days, could foresee, as this book reveals, that the revolution he had effected in scientific theory could also revolutionize the economic life of man and bring, according to the nature of its application, great happiness or great misery upon the human race. The scientists had been honest with him, but to him the world of finance and of politics was essentially dishonest both in foundation and practice. The times were out of joint and it was his failure to set them right that appeared to embitter him. It appeared to embitter him, but his great human heart never really gave up the fight, and this life story also shows that he could if necessary look at himself with a humorous detachment, and continue, in spite of some exasperating habits, to inspire affection and command respect for the way in which he set about his self-imposed quixotic task.

If Soddy ultimately attains the place he deserves in the record of service to mankind it will be due in the first place to his genius as a discoverer, next to his honesty as a thinker, and thirdly to his uncompromising defence of what he felt to be right in principle. There was a danger that even the first of these might have been forgotten, as the almost studied omission of his name from many modern text-books unfortunately shows only too well, while the other two might well have been remembered by a few as the eccentricities of a misplaced genius. Mrs. Howorth's book has brought into the light at a most appropriate moment what might have been tragically obscured, and has given to the present what might have been left for future research to discover only too late.

F. M. BREWER

A PSYCHOLOGICAL STUDY OF TYPOGRAPHY. *By Sir Cyril Burt, with an Introduction by Stanley Morison. Cambridge University Press,* 1958. 30*s net*

In 1932 Mr. Stanley Morison was commissioned to restyle *The Times* newspaper, and in so doing created a typeface now known as 'Times New Roman'. This has since become the most widely used of all types. It can be said then that Mr. Morison

was responsible for setting a new standard of legibility in this country and for putting before us a criterion of design for which both he and *The Times* have become renowned. For this reason it is most fitting that he should have been asked to write the introduction to this book.

With a masterly statement on the true values and standards of fine typography this designer, printer, historian initiates us into the mysteries of printing, explaining the evolution of lettering and telling us why the 'leftist' or '*coterie*' styles have no place in this report. Mr. Morison attempts to evaluate the results of Sir Cyril Burt's experiments and points out that many of the conclusions drawn by the author—who had no previous experience of typographic design—bear out the conventional rules which have guided printers for centuries; rules which have been formed to correspond with the commercial need to satisfy the reader's comfort and yet retain the principles of design which are known to be aesthetically sound.

As Psychologist in the Education Department of the London County Council, Sir Cyril Burt carried out a series of investigations in 1912 to discover 'the influence of school books on eyesight'. A report was published in 1917 and since then most school publishers have kept the standards it suggested.

The present investigation arose from discussions between the author and his colleagues on the printing of books and periodicals dealing with educational and psychological subjects. The results originally appeared in the *British Journal of Statistical Psychology*, of which Sir Cyril Burt is editor. Now revised, expanded, magnificently indexed and impeccably printed in Times New Roman by the Cambridge University Press, it is presented for the general reader.

From the very beginning of what the author refers to as 'this pamphlet', he states clearly that his findings are tentative and inconclusive, as this is the first research in this field. He urges that it should be followed up by a more adequate investigation.

In recent years a wide variety of typefaces have become available for book use; it therefore seemed desirable to Sir Cyril Burt, faced with problems of editorship, that some investigation should be made to discover the legibility and aesthetic merits of those in more frequent use.

By using tests of speed and comprehension, the influences of twenty typefaces, their boldness, size, length of line, interlinear spacing and width of margin were studied. The results of the tests on both adults and children are dealt with separately and at great length. In addition, there are the comments on aesthetic preference by adult readers and historical notes on the specified typefaces. Each typeface is explained and criticized individually, while the outstanding characteristics of their capitals and lower case letters are shown for comparison with each other. It is unfortunate that their arabic numerals could not have been included. Examples of journals and books printed in each face are referred to in the excellent footnotes so that the reader may discover for himself the readability of its characteristics. You are reading at this moment, the characters of Imprint the typeface which seemed to give most satisfaction to the greatest number of persons tested. However, it is interesting to note that printed matter seems more legible and reading becomes more accurate and faster when set in a type which the reader, perhaps without realizing it, finds aesthetically pleasing.

M. R. PRESTON

BRITISH SHOPPING CENTRES: NEW TRENDS IN LAYOUT AND DISTRIBUTION. *By Wilfred Burns. London, Leonard Hill,* 1959. 45*s net*

This is a book many will be happy to have on their library shelves; town planning, however, is an art as well as a science, and having read and absorbed much of the most valuable information and ideas, those concerned with the location of shopping centres, their layout and design, may well need to be guided in the most part by commonsense and by the existing pattern of development. The opportunities for

completely redesigning shopping centres, re-grouping and clearing away 'poverty' shops, are unfortunately on a limited scale in most towns.

Mr. Burns has followed a logical pattern in the layout of his book, which is eminently readable; the bibliography is excellent and surprisingly long—it is often said that there is little information on shops.

The patterns of shopping distribution on pages 36 and 37 are familiar. How rarely are such patterns recognized or realizable in practice! Theory is a good discipline for a study of most problems and Mr. Burns' statements in Chapter IV are very practical and remarkably well informed.

The car and the commercial vehicle dominate the approach to planning to-day. In a hundred years to come this may be regarded as a passing problem of the twentieth century; how many buildings erected in the first quarter of this century will be standing within 100 years? Mr. Burns might well have referred to the economic and structural life of buildings in shopping centres in the light of the present domination of the problem by present day car-parking requirements.

L. N. FRASER

SHORT NOTES ON OTHER BOOKS

WORK STUDY IN THE OFFICE. *By Harry P. Cemach. London, Current Affairs Ltd.*, 1958. 25*s*

Mr. Cemach's belief is that the only way to increase productivity in the office is by the work study approach of systematic investigation and scientific analysis. This approach he applies to a number of office methods, with appreciable results, and he makes it plain that work study is no more new fangled and unnecessary in a business house than in a factory.

BRISTOL TO-DAY. *By Reece Winstone, with a preface by John Betjeman. Bristol, Reece Winstone*, 1958. 10*s* (*post paid*)

Continuing his admirably planned photographic survey of Bristol, Mr. Winstone here shows the city in its present aspects and moods. There are interesting sections devoted to W. Friese Greene and to American associations with Bristol, and a useful map. It is perhaps a pity that the view of the nave of St. Mary Redcliffe is not reproduced better and in a larger size.

MODERN ART—A PICTORIAL ANTHOLOGY. *Edited by Charles McCurdy. New York, the Macmillan Company*, 1958. 48*s* 6*d net*

The period covered is from 1850–1957, and within those dates significant developments in painting, sculpture, architecture and design are illustrated by over 1,000 pictures. A valuable feature of the anthology, which has been compiled by American authorities, is the extensive bibliography, which gives much information concerning both individual artists and the Movements to which they belonged.

TECHNOLOGY AND THE ACADEMICS. *An Essay on Universities and the Scientific Revolution. By Sir Eric Ashby. London, Macmillan*, 1958. 15*s net*

In this series of lectures delivered at the University College of North Wales in 1958, Sir Eric Ashby describes the condition of British universities in the days before scientific thought made any appreciable impact on them, and then examines their growing response to the demands of science and technology from the nineteenth century until now.

LIBRARY ADDITIONS

BIOGRAPHY

HUDSON, DEREK—Sir Joshua Reynolds: a personal study; with Reynold's 'Journey from London to Brentford' now first published. *London, Bles*, 1958.

ROLT, LIONEL THOMAS CASWALL—Thomas Telford. *London, Longmans, Green*, 1958.

HISTORY AND TOPOGRAPHY

BRETT, JAMES, NORMAN G.—The growth of Stuart London. *London, George Allen & Unwin, for the London and Middlesex Archæological Society*, 1935.

BUER, M. C.—Heath, wealth and population in the early days of the industrial revolution. *London, G. Routledge*, 1926.

CARVEL, JOHN L.—The new Cumnock coal-field, a record of its development and activities. *Edinburgh, T. and A. Constable*, 1946. Presented by Lord Nathan.

CARVEL, JOHN L.—One hundred years in coal, the history of the Alloa Coal Company. *Edinburgh, T. and A. Constable*, 1944. Presented by Lord Nathan.

COLEMAN, DONALD CUTHBERT—The British paper industry, 1495–1860: a study in industrial growth. *Oxford, Clarendon Press*, 1958.

HAMMOND, J. L. *and* HAMMOND, BARBARA—The village labourer, 1760–1832; a study in the government of England before the Reform Bill. *London, Longmans Green & Co.*, 1920.

O'DEA, WILLIAM THOMAS—The social history of lighting. *London, Routledge & K. Paul*, 1958.

PEVSNER, NIKOLAUS [BERNARD LEON]—North Somerset and Bristol. *Harmondsworth, Penguin Books*, 1958. (*Buildings of England series, no.* 13.)

ROGERS, JAMES E. THOROLD—The economic interpretation of history; lectures delivered in Worcester College Hall, Oxford, 1887–8. 2nd ed. *London, T. Fisher Unwin*, 1891.

*SINGER, CHARLES [JOSEPH], *and others (editors)*—A history of technology. *Oxford, Clarendon Press*. Vol. 4: The Industrial Revolution, *c.* 1750 to *c.* 1850, 1958. Presented by Imperial Chemical Industries Ltd. *Vol. 5: The late nineteenth century, *c.* 1850 to *c.* 1900, 1958. Presented by Imperial Chemical Industries.

STENTON, *Sir* FRANK MERRY, *editor*—The Bayeux tapestry: a comprehensive survey. *London, Phaidon Press*, 1957.

TAWNEY, RICHARD HENRY, *editor*—Studies in economic history: the collected papers of George Unwin. *London, Macmillan & Co.*, 1927.

TOYNBEE, ARNOLD—Lectures on the industrial revolution of the eighteenth century in England; popular addresses, notes and other fragments. *London, Longmans, Green*, 1919.

FROM THE JOURNAL OF 1859

VOLUME VII. 30*th September*

HOSPITALITY AT BALMORAL

The twenty-ninth annual meeting of the British Association for the Advancement of Science, held at Aberdeen under the Presidency of the Prince Consort, had just concluded.

On Thursday, the 22nd September, a party of about two hundred members of the Association left Aberdeen at six o'clock in the morning for Balmoral Castle, on the invitation of Her Majesty and the Prince Consort. They had a special train to Banchory, about eighteen miles, and posted the remainder of the journey, thirty-two

miles, in carriages, previously arranged by the Local Committee to meet them at that place. The day was not very propitious, rain coming on previously to their arrival, showers and wind, with intervals of sunshine, succeeding each other during the whole of the afternoon. The party arrived at Balmoral shortly before two o'clock. Holiday was kept at the Castle. The Farquharson, Duff, and Forbes Highlanders marched in bodies to the grounds, and there were Highland games in part of the Palace. Her Majesty, the Prince Consort, the Prince of Wales, and other members of the Royal Family, braved wind and weather, and watched the games with great interest, Her Majesty presenting the prizes with her own hand to the successful competitors. A déjeuner was served for the members of the Association in the ball-room of the Castle, and at six o'clock the party started homeward, reaching Aberdeen about one o'clock in the morning.

During the visit a telegram arrived for Sir Roderick Murchison, announcing the arrival of the *Fox* with the news of Captain M'Clintock's successful search for information setting at rest the fate of the long missing Franklin Expedition.

PROGRESS AT KEW

From an official report made by the Director of the Botanic Gardens.

On the transference, in 1841, of the botanic gardens, by the Royal Family to the public, they consisted only of 11 acres, and were extended by successive additions till, in 1847, they had reached their present dimensions of 75 acres; this is exclusive of the pleasure grounds. As regards the number of visitors, beginning with 9,174 in 1841, the increase has been gradual to 405,376 in 1858 (exclusive of those to the herbarium and library); while the generally good behaviour of this mass of people, often inconveniently crowding the plant-houses and museums, the eagerness with which they inspect the more curious and interesting plants and their products, and read the notices and explanations given in the guide books and attached to the objects in the museum, all evince that such privileges minister food to the mind as well as health to the body.

The greatest number of persons admitted in one day to the gardens (where they have free access to all parts), has been 13,761. The best attended months, as may be supposed, are June, July, and August, during which we have numbered so many as 267,223 persons. The fewest visitors are in November, December and February, when they have been so low as 4,679.

The hours of admission to the Royal Gardens are from 1 p.m. till dusk, on week-days, and from 2 p.m. on Sundays. On Christmas day only they are wholly closed.

Incessantly are applications, personal and written, made for leave to visit the gardens before 1 p.m.; but they are necessarily refused, except to persons who have actual business or other claims to be admitted. Considering that, as previously explained, the whole of the work in the houses and museums must be concluded before noon (the dinner hour for the men), it is obvious that the exclusion of the general public till 1 p.m. must be rigidly enforced; otherwise the foremen cannot be answerable for the safety of their respective collections, or the steady working of their gardeners, who are often addressed, and are in many ways interrupted in their duties, by strangers.

Connected with the garden establishment is a very important feature—the Gardener's Library and Reading Room. It consists of two small apartments, adjoining the Director's office, and contains a selection of the more useful works on Horticulture, Elementary Botany, Geography, and Physics, Agriculture Chemistry, Landscape Gardening, and a few volumes of Voyages and Travels, together with two horticultural weekly journals, some maps, and a small supply of stationery for the use of readers. It is open every evening for the gardeners, under the direction of the curator and foremen.